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ABSTRACT

This competency-based curriculum guide on the specialty area of concrete masonry is part of the Introduction to Construction series. The series is designed with the flexible training requirements of open shop contractors, preapprenticeship programs, multicraft high school programs, technology education programs, and cooperative education programs in mind. This guide contains four instructional units: concrete materials, concrete tools, concrete layout, and concrete basic skills. Eight basic components form a unit of instruction: performance objectives (unit and specific objectives), suggested activities for the teacher (an outline of unit contents and an instructor's guide), information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. (YLB)

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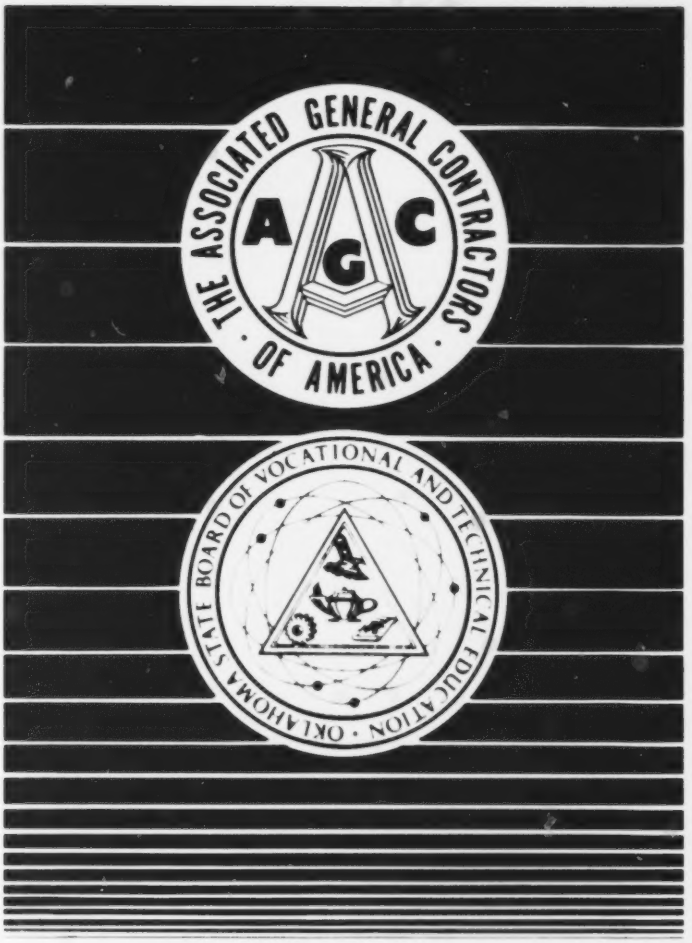

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Introduction to Concrete Masonry

CE051495

Introduction to Construction Series

instructor edition

88-005713

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INTRODUCTION TO CONCRETE MASONRY
COMPETENCY PROFILE

Student _____ Soc. Sec. No. ___ ___ ____
Last First MI

PROGRAM _____ Grade 9 10 11 12 Adult SCHOOL _____

INSTRUCTOR _____ SCHOOL ADDRESS _____ PHONE _____

STUDENT'S HOME ADDRESS _____ DATE OF BIRTH _____ PHONE _____

STUDENT'S EMPLOYER _____ ADDRESS _____ PHONE _____

CONTACT IN CASE OF EMERGENCY: _____ PHONE _____

ADDRESS _____

OR

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ON-JOB TRAINING/WORK EXPERIENCE

DURATION OF EMPLOYMENT	JOB TITLE	EMPLOYER	SUPERVISOR'S NAME	ADDRESS OF EMPLOYER	PHONE

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SPECIFIC JOB COMPETENCIES

Directions: Evaluate the trainee using the rating scale below and check the appropriate number to indicate the degree of competency achieved. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below. The written test score line is provided for optional teacher use. It may not be applicable in all cases. "NA" is an appropriate entry in such instances.

Rating Scale:
4 — Skilled — can perform independently with no additional training.
3 — Moderately Skilled — has performed independently during training program, limited additional training may be required.
2 — Limited Practice — has practiced during training program, additional training is required to develop skill.
1 — Exposure Only — general information provided with no practice time, close supervision needed and additional training required.
0 — No Exposure — no information nor practice provided during training program, complete training required.

4 3 2 1 0
☐☐☐☐☐ *Concrete Materials*
☐☐☐☐☐ 1. _____

WRITTEN TEST SCORE _____

4 3 2 1 0
☐☐☐☐☐ *Concrete Tools*
☐☐☐☐☐ 1. Complete a safety test pertaining to power tools.
☐☐☐☐☐ 2. _____

WRITTEN TEST SCORE _____

4 3 2 1 0
☐☐☐☐☐ *Concrete Layout*
☐☐☐☐☐ 1. Use a framing square and rule to lay out a square corner.
☐☐☐☐☐ 2. Use a level.
☐☐☐☐☐ 3. _____

WRITTEN TEST SCORE _____

4 3 2 1 0
☐☐☐☐☐ *Concrete Basic Skills*
☐☐☐☐☐ 1. Set and drive nails with a nail hammer.
☐☐☐☐☐ 2. Use a crosscut handsaw.
☐☐☐☐☐ 3. Construct edge forms for a sidewalk.
☐☐☐☐☐ 4. Construct edge forms for a slab on grade.
☐☐☐☐☐ 5. Use a bullfloat.
☐☐☐☐☐ 6. Use a hand float and finishing trowel.
☐☐☐☐☐ 7. Use an edger.
☐☐☐☐☐ 8. Operate a power trowel machine.
☐☐☐☐☐ 9. Operate an electric sprayer.
☐☐☐☐☐ 10. _____

WRITTEN TEST SCORE _____

Use of This Document

This document can be used to record information about the student and the skills mastered by the student. This information is useful in documenting student progress during the training program and to provide information about the student's qualifications to potential employers and for entry into advanced training programs. Instructors using AGC-CIMC instructional materials are authorized to reproduce this document as required for use in their training programs.

INTRODUCTION TO CONCRETE MASONRY

Developed as a Cooperative Project by
The Associated General Contractors of America
William K. Healy, Chairman, Manpower and Training Committee
and
Oklahoma State Board of Vocational and Technical Education
John Folks, Chairman
Roy Peters, Jr., Director

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INTRODUCTION TO CONCRETE MASONRY

TABLE OF CONTENTS

Unit I Concrete Materials ITCM-1

Unit II Concrete Tools ITCM-39

Unit III Concrete Layout ITCM-147

Unit IV Concrete Basic Skills ITCM-175

A more advanced curriculum on concrete masonry is available from The Associated General Contractors of America, 1957 E Street, N.W., Washington DC 20006, phone (202) 393-2040 or contact the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364.

FOREWORD

In 1985, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project, a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This publication is the result of those original discussions and close coordination among general contractors and vocational educators. This series represents a conscious effort to coordinate the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

Although this series reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Introduction to Concrete Masonry* should be adapted and modified to coincide with local conditions.

Roy Peters, Jr., Director
Oklahoma State Department of
Vocational and Technical Education

William K. Healy, Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

For many years The Associated General Contractors of America (AGC) has recognized the need for providing quality compentency-based instructional materials for the construction industry. AGC and the Oklahoma State Department of Vocational and Technical Education have met this challenge by providing nationally recognized curriculum and services since 1972. In 1986 AGC and Oklahoma's Curriculum and Instructional Materials Center (CIMC) determined a significant need for a series that would address training needs of open shop contractors, preapprenticeship programs, multi-craft high school programs, technology educational programs, CVET, and cooperative education programs. The Introduction to Construction Series was designed with the flexible training requirements of these groups in mind.

The Introduction to Construction Series begins with *Fundamentals to Construction* and progresses to twelve spin-off specialty publications. *Fundamentals of Construction* covers basic knowledge necessary for all individuals in construction. Each specialty area covers basic skills necessary for entry-level employment. Both vocational education and the construction industry offer more advanced courses in each specialty area and should be considered by individuals wishing to establish careers in the industry. Competency profiles (provided in the teacher edition) for the Introduction to Construction Series articulate with several more advanced AGC publications as well as publications developed by the Mid-America Vocational Curriculum Consortium (MAVCC).

Publications in this series include:

- Introduction to Bricklaying
- Introduction to Carpentry
- Introduction to Concrete Masonry
- Introduction to Ironwork
- Introduction to Electricity
- Introduction to Plumbing
- Introduction to Heating, Ventilation, and Air Conditioning
- Introduction to Sheet Metal
- Introduction to Roofing
- Introduction to Drywall
- Introduction to Insulation
- Introduction to Welding

USE OF THIS PUBLICATION

Instructional Units

Introduction to Concrete Masonry contains one section and four instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
  - Supplies and equipment needed
  - Amount of practice needed
  - Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

Suggested activities are included only in teacher materials. The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review or practice materials such as crossword puzzles and self-tests, or charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary. Order transparencies from the Curriculum and Instructional Materials Center, or make transparencies and place them in the notebook where they will be immediately available for use.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided

when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (yellow pages)

The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units coverec may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Introduction to Concrete Masonry* has been abbreviated ITCM. The units are then numbered consecutively within each section. An example of a page number is ITCM-1. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

For best results, provide student materials for each student. Student materials contain everything but the test, supplements, answers to assignment sheets, and suggested activities.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. A competency profile master is provided in the instructor edition of each publication. Duplicate the profile and distribute to students as required.

Other AGC Publications: AGC updates curriculum products on a continuing basis. For a free catalog describing other AGC products, call the AGC National office at 1-202-393-2040.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. You can mail the information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, it is important that you notify the (CIMC) of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator for Curriculum Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

CONCRETE MATERIALS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the ingredients used in making good concrete and the functions of the common types of admixture classes. The student will show this ability by completing the assignment sheet and the unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with concrete materials.
2. Select from a list basic raw materials used in portland cement.
3. List most common types of portland cement and how they are used.
4. Name the properties of cement suitable for use as an ingredient in concrete.
5. State properties of water suitable for use as an ingredient in concrete.
6. Briefly discuss the importance of proper water-cement ratio.
7. Briefly discuss the effects of using impure water as an ingredient in concrete.
8. State properties of aggregates suitable for use as an ingredient in concrete.
9. State categories of aggregate sizes and their definitions.
10. List classes of artificial aggregates and materials used in each class.
11. State functions of each of the common admixture classes.

CONCRETE MATERIALS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

1. Supplements

a. Supplement #1 — Artificial Aggregates Used in Making Concrete

b. Supplement #2 — Common Admixtures Classified by Function

2. Transparency Master #1 — Basic Raw Materials for Making Portland Cement

C. Information sheet

D. Assignment Sheet #1 — Compare Benefits and Cost of Using Admixtures

E. Answers to assignment sheet

F. Test

G. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Slides of projects where inferior concrete was used

2. Cross-section sample of good concrete

3. Cross-section samples of poor or inferior concrete

4. Slide presentation

History of the Cement Business (SS 176), 1981. 35 slides with notes. Available from Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077.

(NOTE: These slides review the development of the cement manufacturing process from Roman to modern times. Includes uses of natural cement, the invention of portland cement in England, and the birth of the American cement industry.)

SUGGESTED ACTIVITIES

C. Introduce unit.

- Ask students whether or not they have ever seen projects where concrete of inferior quality was used. List qualities of inferior concrete on the chalkboard.
- Show students slides of projects where inferior concrete was used. Discuss the fact that inferior concrete ingredients can cause inferior concrete.
- Provide students with objective sheet and discuss unit and specific objectives, emphasizing the properties of quality concrete ingredients.
- Take students on a field trip to a concrete batch plant. Show students the sieves used at the plant to analyze aggregate size, the various methods used to test concrete ingredients, and the methods of mixing concrete ingredients.

D. Provide students with information and assignment sheets.

E. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with concrete materials.
   - Review the definitions of *concrete* and *cement*. Emphasize that cement is an ingredient in concrete.
   - Review the safety rules for proper dress when working with concrete. Stress that fresh concrete is highly alkaline and can cause skin irritation, eye infection, and severe skin burns.
   - Discuss the term *aggregate*. Emphasize the economic reasons for using filler material to provide volume by stating that aggregates account for 60 to 80 percent of the volume of concrete.
2. Use Information Sheet, Section II, to discuss basic raw materials used in portland cement.
   - Show slide presentation *History of the Cement Business*.
   - Take a tour of a cement plant so that students can observe the materials and processes used in the making of portland cement.
   - Display samples and discuss the various types of raw materials that are used in making portland cement; such as limestone, marlde, marl, oyster shells, waste sludge from lime plants, clay, shale, bauxite, silica sand, iron ore, waste from aluminum plants, and slag from blast furnaces.

SUGGESTED ACTIVITIES

- Explain that cement is the key ingredient of concrete and that concrete is probably the most widely used building material in the world.

- As you tour the plant, discuss the different steps in the production of portland cement, such as quarrying raw materials, grinding and mixing the raw materials, blending or proportioning raw materials, fine grinding and mixing again, burning raw materials, and finish grinding. This final grinding produces cement in a powder finer than flour or face powder; it is so fine it will pass through a sieve with 40,000 openings per inch.

3. Use Information Sheet, Section III, to discuss common types of portland cement and how they are used.

   - Discuss the various types of portland cements, how and where they may be used. Explain to the students that they will probably never use all of these types or even see all of them.

   - Explain that type I is the most common and will probably be the only type they will work with during their training period.

4. Use Information Sheet, Section IV, to discuss the properties of cement suitable for use as an ingredient in concrete.

   - Explain to students that cement is often sold in bulk and then stored for periods of time, and that sometimes during storage, the cement may become lumpy. These lumps may be caused from exposure to moisture or from compaction. Lumps caused from exposure to moisture make the cement unsuitable as an ingredient in concrete, but lumps caused by compaction, called *warehouse pack*, do not affect the quality of the cement or the concrete.

   - Demonstrate the test for determining whether or not the lumps found in cement make it unsuitable for use as an ingredient in concrete. Hold a lump of cement between your thumb and forefinger and then press your fingers together. If the lump cannot be pulverized, it was probably caused by water absorption and the cement should not be used. If the lump is easily pulverized, it was probably caused by compaction and the cement can be used.

5. Use Information Sheet, Sections V through VII, to discuss the properties of water suitable for use as an ingredient in concrete, water cement ratio, and the effects of using impure water as an ingredient in concrete.

   - Explain the general rule of thumb that drinkable water with no pronounced taste or odor is probably free from impurities and therefore suitable as an ingredient in concrete.

   - Emphasize that using water with excessive impurities affects concrete's setting time and strength, stains concrete, and corrodes reinforcing material. To prevent these undesirable effects, it is best to use water that has been analyzed. However, if unanalyzed water must be used, it is a good practice to make concrete strength tests to determine the suitability of the water.

SUGGESTED ACTIVITIES

- Discuss or demonstrate the strength tests used to determine the suitability of mixing water.

- Visit or have a representative from a testing laboratory show examples of breaking test samples.

6. Use Information Sheet, Sections VIII through X, to discuss properties of aggregates suitable for use as an ingredient in concrete, aggregate sizes, and artificial aggregates.

   - Show examples of aggregates and explain that the natural aggregates sand, gravel, and crushed stone are most commonly used in producing concrete, where they serve as filler material that is bound together by the cement-and-water paste. Further explain that most aggregates are classified by size as being *fine* or *coarse* and that good concrete contains a well-graded mixture of both fine aggregate (sand) and coarse aggregate (gravel or crushed stone). However, because supplies of natural aggregates are running low and because of new building requirements, artificial aggregates are often used in making concrete. Use Supplement #1, "Artificial Aggregates Used in Making Concrete," to illustrate your discussion.

   - Show the sieves used for grading aggregates: fine aggregates are graded with sieves ranging from a #100 to #4 screen size; coarse aggregates are graded with sieves ranging from #4 to a 6-inch screen size.

   - Emphasize that whatever the aggregate used, it must be well-graded, clean and free from impurities, abrasion-resistant, freeze/thaw-resistant, cuboid-shaped, durable, and hard. If an aggregate is not cuboid in shape, the cement paste will be more expensive to produce. If an aggregate is not well-graded and contains impurities such as dust, silt, loam, clay, or vegetable matter, the setting time may be affected and the cement paste will not bind properly. If an aggregate is not abrasion-resistant, hard, and durable, the hardened concrete will not be as strong and will wear or weather rapidly.

   - Show samples of poor concrete containing poorly graded, flaky, weak, friable, or shale-laminated aggregate particles.

7. Use Information Sheet, Section XI, to discuss common admixture classes and their functions.

   - Have students refer to Supplement #2, "Common Admixtures Classified by Function," while you review the information presented in Section II. Then have students break into groups of two. Have one student show the side of a flash card with an admixture class name and have the other student give the function of that admixture class. Have students keep score of the functions they are able to correctly identify. Have students trade places and repeat the exercise.

SUGGESTED ACTIVITIES

- Have students complete Assignment Sheet #1.

F. Review unit.

G. Give test.

H. Critique test and discuss in class.

I. Reteach and retest as necessary.

J. Complete appropriate sections of competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

III. Unit references

A. Hendrix, Laborn J. "Bud." *Cement Masonry Curriculum*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

B. Hendrix, Laborn J. "Bud." *Fundamentals of Concrete and Cement Masonry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — ARTIFICIAL AGGREGATES USED IN MAKING CONCRETE

Normally sand, gravel, and crushed stone are used as aggregates to make concrete. However, new artificial aggregate materials are being developed today because supplies of natural sands and gravels are running low and because of the weight requirement needed to meet new applications for concrete as a building material. The following is a listing of some of these artificial aggregates and their uses.

Classes of artificial aggregates

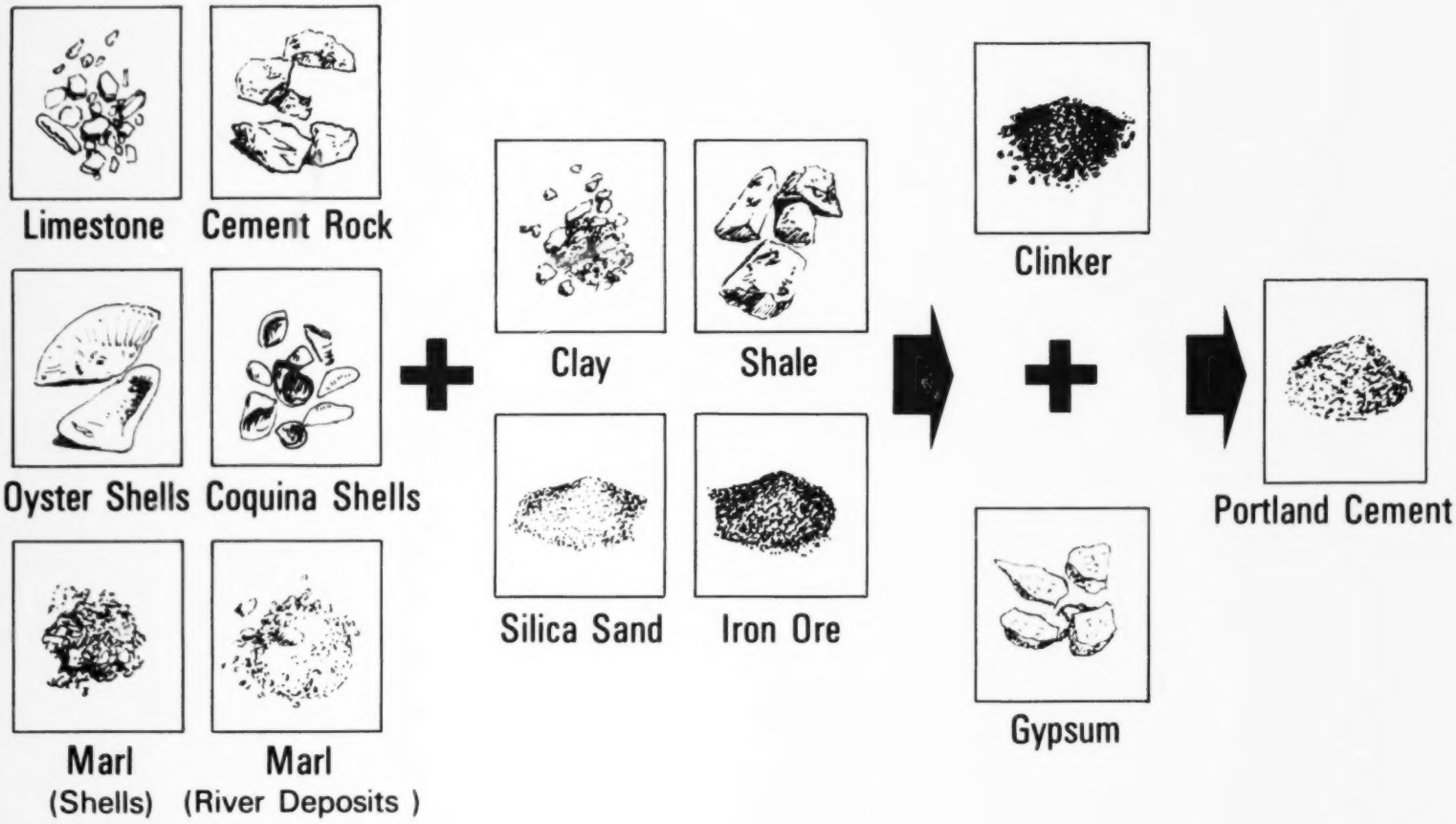
Class	Unit weight per cubic foot	Aggregates used	Uses
Ultra-lightweight	4 to 30 pounds	Vermiculite Expanded glass Ceramic spheres Carbonized cereals Expanded plastics Perlite	Used for making lightweight concretes that can be sawed or nailed; also used for its insulating properites
Lightweight	40 to 70 pounds	Expanded clay Expanded shale Expanded slate Sintered fly ash Expanded slag Furnance clinker Crushed brick Petroleum coke	Used primarily for making concretes that will reduce the dead load of structures; also used for its insulating properties
Normal-weight	70 to 110 pounds	Iron slag Glass frits Calcined bauxite Compacted cement	Used for normal concrete projects
Heavyweight	Excess of 120 pounds	Steel or iron shot Steel or iron pellets Steel or iron punchings	Used for making high-density concretes for shielding against nuclear radiation

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — COMMON ADMIXTURES CLASSIFIED BY FUNCTION

Class	Function	Agent
Air-entraining	Improve durability Increase workabilty Reduce bleeding	Salts of wood resins Some synthetic detergents Salts of sulfonated lignin Salts of petroleum acids Fatty and resinous acids and their salts Alkylbenzene sulfonates
Retarding	Delay setting time Offset adverse high-temperature weather conditions	Lignin Borax Sugars Tartaric acid and salts
Accelerating	Speed setting time Speed early-strength development Offset adverse low-temperature weather conditions	Calcium chloride Triethanolamine
Water-reducing	Reduce quantity of mix water needed for a given consistency Increase workability without decreasing strength Increase slump	Lignosulfonates Hydroxylated carboxylic acids
Superplasticizer (high-range water-reducing)	Greatly reduce quantity of mix water needed Increase workability without decreasing strength Increase slump	Sulfonated melamine formaldehyde condensates Sulfonated naphthalene formaldehyde condensates
Pozzolan	Improve workability Improve plasticity	Natural materials: Diatomaceous earth Opaline cherts and shales Tuffs and pumicites Artificial material: Fly ash
Waterproofing and dampproofing	Decrease permeability Preserve designed strength	Stearate of calcium, aluminum, ammonium, or butyl Petroleum greases or oils Soluble chlorides
Pigment	Add color	Pure mineral oxides
Fiber reinforcement	Reduce surface cracking Increase strength Decrease permeability	Plastic fiber Metal fiber

Basic Raw Materials For Making Portland Cement



CONCRETE MATERIALS
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with concrete materials

A. **Concrete** — Building material made by mixing cement, water, and aggregates

(NOTE: Fresh concrete is highly alkaline [caustic] and can cause skin irritation, eye infection, and in some cases severe skin burns. Always wear protective clothing and follow strict safety precautions when working with fresh concrete.)

B. **Cement** — Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete

C. **Aggregate** — Filler material used in concrete to provide volume at low cost

(NOTE: Aggregates make up about 60 to 80 percent of the volume of concrete. Sand, gravel, and crushed stone are the most commonly used aggregates.)

D. **Bind** — To cause to stick together

E. **Setting time** — Time required for concrete to become firm or solid

F. **Cuboid** — Approximately cube-shaped

G. **Admixture** — Agent added to concrete mix immediately before or during mixing to alter one or more concrete characteristic

H. **Workability** — Ease with which concrete can be placed, consolidated, and finished

I. **Bleeding** — Emergence of mixing water on the surface of newly placed concrete; caused by settling of solid materials within the mass

J. **Slump** — Measure of consistency of freshly mixed concrete

K. **Pozzolan** — Material that when combined with moisture will react with calcium hydroxide at ordinary temperatures to form compounds possessing properties of cement

L. **Plasticity** — Capacity for being flexible or workable

M. **Permeability** — Degree to which liquids or gases are capable of passing through a substance

II. Basic raw materials used in portland cement

A. Lime

B. Silica

C. Alumina

INFORMATION SHEET

D. Iron ore

E. Gypsum

III. Most common types of portland cement and how they are used

A. Type I — Normal portland cement; general purpose

B. Type II — Modified portland cement for moderate sulfate resistance, lower heat of hydration; generally used for massive construction

C. Type III — High-early-strength portland cement; used when high strength at an early age is desired

D. Type IV — Low-heat portland cement; used where rate of heat must be kept at a minimum, necessary only in massive construction

E. Type V — Sulfate-resistant portland cement; used only in construction that is exposed to severe sulfate action

F. White portland cement — Pure white-colored cement, generally used for architectural purposes

(NOTE: There are several other types of cement that are used for special projects.)

IV. Properties of cement suitable for use as an ingredient in concrete

A. Dry and free-flowing

(NOTE: Cement will retain its cementing quality indefinitely if it does not come into contact with moisture.)

B. Free of lumps

(NOTE: If the cement has been exposed to moisture and contains lumps that cannot be pulverized when pressed between your thumb and forefinger, do not use it as an ingredient in concrete.)

V. Properties of water suitable for use as an ingredient in concrete

(NOTE: Generally, water that is fit to drink is suitable for making concrete.)

A. Tasteless and odorless

INFORMATION SHEET

B. Clean and free of impurities

EXAMPLES: Salts, minerals, industrial wastes, algae

(NOTE: Water departments will usually provide an analysis of local water. However, when water that has not been analyzed and may contain unknown impurities is considered for use, particularly on large jobs, it is a good practice to make a concrete strength test.)

VI. Importance of proper water-cement ratio

A. Total amount of water mixed with the cement determines quality of paste

B. Water-cement ratio and the extent of chemical reactions between the cement and the water govern quality of the hardened paste

VII. Effects of using impure water as an ingredient in concrete

A. Reduces cement's bonding ability

B. Affects concrete's setting time

(NOTE: Some impurities retard concrete's setting time, while some accelerate the setting time.)

C. Stains concrete

D. Corrodes steel used as reinforcing material

(NOTE: Some of these effects are long range and cannot be seen.)

VIII. Properties of aggregates suitable for use as an ingredient in concrete

A. Well-graded

(NOTE: A well-graded aggregate consists of a mixture of both coarse and fine aggregate particles combined so that the smaller particles fit among the larger ones. See Figure 1. This type of mixture produces a more economical concrete since it requires less cement paste to create a bond than would otherwise be necessary to produce a given quality of concrete.)

EXAMPLE: Well-graded aggregate

TEST

b. 1) Class _____

2) Materials _____

c. 1) Class _____

2) Materials _____

d. 1) Class _____

2) Materials _____

11. State one function of each of the common admixture classes listed below.

a. Air-entraining — _____

b. Retarding — _____

c. Accelerating — _____

d. Superplasticizer (high-range water-reducing) — _____

e. Pozzolan — _____

f. Water-reducing — _____

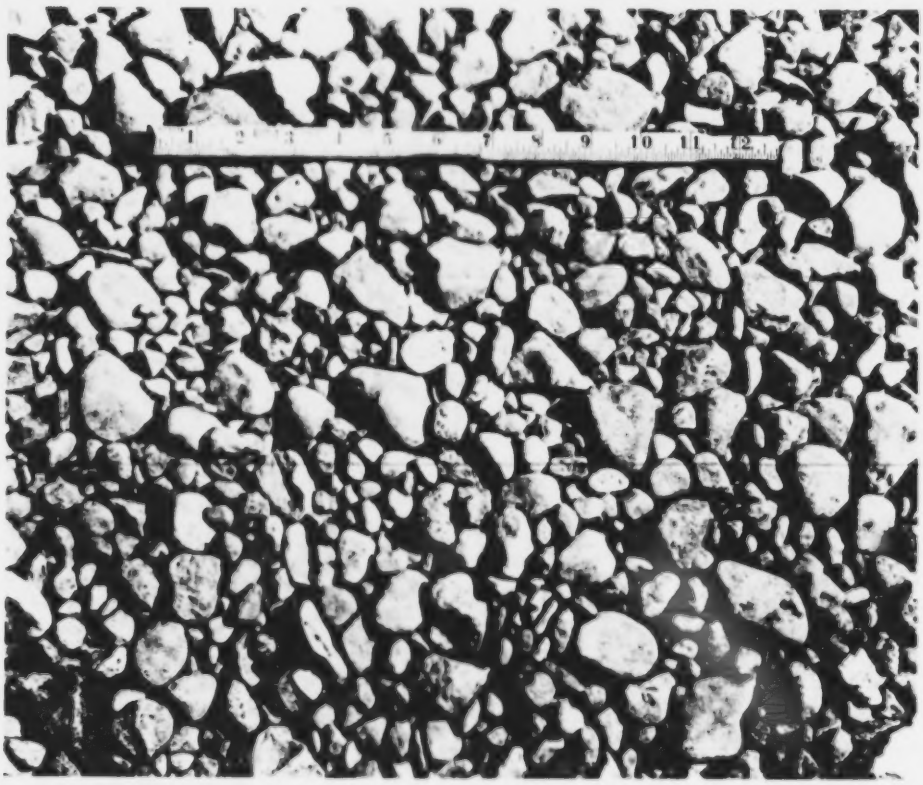
g. Waterproofing and dampproofing — _____

h. Pigment — _____

i. Fiber reinforcement — _____

INFORMATION SHEET

FIGURE 1



Courtesy of Portland Cement Association

B. Clean and free from fine dust, silt, loam, clay, or vegetable matter

(NOTE: The impurities listed prevent the cement paste from properly binding the aggregate particles together.)

C. Abrasion-resistant

(NOTE: Abrasion resistance is essential when the aggregate is used in concrete surfaces such as floors and walls that are subject to abrasion.)

D. Freeze/thaw-resistant

(NOTE: If the particles of aggregate used in concrete are not freeze/thaw resistant, they will weaken the strength of the concrete.)

INFORMATION SHEET

E. Approximately cuboid

(NOTE: Particles with flat, elongated shapes require more cement paste to produce workable concrete and are therefore more expensive to use than cube-shaped particles. However, the shape of the aggregate does not affect the strength of the concrete.)

F. Hard and durable

(NOTE: Aggregates that are soft, flaky, and wear rapidly when exposed to weather weaken the strength of the concrete.)

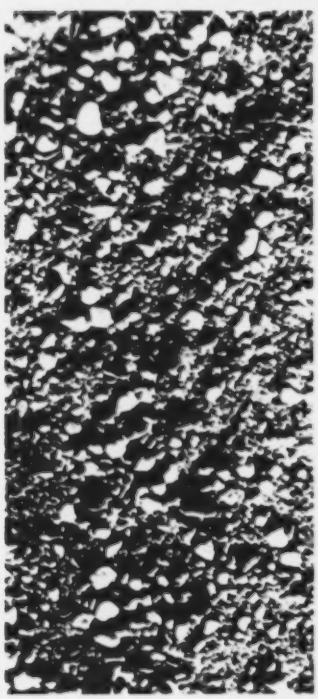
IX. Categories of aggregate sizes and their definitions

(NOTE: Aggregate sizes are determined by sieve analysis.)

A. Fine — Aggregate containing particles ranging in size from very fine up to ¼ inch (Figure 2)

EXAMPLE: Fine aggregate

FIGURE 2



Courtesy of Portland Cement Association.

INFORMATION SHEET

B. Coarse — Aggregate containing particles ranging in size from 1/4 inch up to the largest size that can be used on a job (Figure 3)

(NOTE: The most common coarse aggregate sizes are 3/8, 1/2, 3/4, 1, 1 1/2, and 2 inch.)

EXAMPLE: Coarse aggregate

FIGURE 3

Courtesy of Portland Cement Association.

X. Classes of artificial aggregates and materials used in each class

(NOTE: Normally sand, gravel, and crushed stone are used as aggregates to make concrete. However, new artificial aggregate materials are being developed because supplies of natural sands and gravels are running low and because of the weight requirements needed to meet new applications for concrete as a building material. The following is a list of these artificial aggregates.)

A. Ultra-lightweight — Vermiculite, expanded glass, ceramic spheres, carbonized cereals, expanded plastics, perlite

(NOTE: Ultra-lightweight aggregates weigh from 4 to 30 pounds per cubic foot. They are used for making light concretes that can be sawed or nailed or used for their insulating properties.)

INFORMATION SHEET

B. Lightweight — Expanded clay, expanded shale, expanded slate, sintered fly ash, expanded slag, furnace clinker, crushed brick, petroleum coke

(NOTE: Lightweight aggregates weigh from 40 to 70 pounds per cubic foot. They are used primarily for making light concretes that reduce the dead load of structures or light concretes used for their insulating properties.)

C. Normal-weight — Iron slag, glass frits, calcined bauxite, compacted cement

(NOTE: Normal-weight aggregates weigh from 70 to 110 pounds per cubic foot. They are used for ordinary concrete construction projects.)

D. Heavyweight — Steel or iron shot, steel or iron pellets, steel or iron punchings

(NOTE: Heavyweight aggregates weigh in excess of 120 pounds per cubic foot. They are used for making high-density concretes for shielding against nuclear radiation.)

XI. Common admixture classes defined by function

(NOTE: Quality concrete should be workable, strong, durable, and watertight. These properties can usually be produced most economically by selecting quality basic concrete ingredients: cement, water, and aggregates. However, sometimes conditions require concrete properties that extend or reduce setting time, accelerate early-strength development, increase workability, or improve weather resistance. Then, admixtures are added to the mix design before or during mixing.)

A. Air-entraining

(NOTE: Air-entraining agents such as salts of wood resins, some synthetic detergents, salts of sulfonated lignin, salts of petroleum acids, fatty and resinous acids and their salts, and alkylbenzene sulfonates are used to entrain microscopic air bubbles in concrete to permit the use of harsher and more poorly graded aggregates and to improve concrete resistance to freeze/thaw cycles and deicing chemicals.)

1. Improve durability
2. Increase workability
3. Reduce bleeding

B. Retarding

(NOTE: Retarding admixtures such as lignin, borax, sugars, and tartaric acid and salts are used in concrete [1] to offset the accelerating effects of hot weather on the setting of concrete and [2] to delay the set when difficult or unusual conditions of placement are required. Because most retarding admixtures also act as water-reducing agents, you may also hear them being referred to as *water-reducing retarders*.)

1. Delay setting time

2. Offset adverse high-temperature weather conditions

C. Accelerating

(NOTE: Accelerating admixtures such as calcium chloride and triethanolamine are used during cold weather to accelerate set so that forms can be removed earlier and also to make concrete more resistant to freezing at an early age.)

1. Speed setting time
2. Speed early-strength development
3. Offset adverse low-temperature weather conditions

D. Water-reducing

EXAMPLES: Lignosulfonates, hydroxylated carboxylic acids

1. Reduce quantity of mix water needed for a given consistency
2. Increase workability without decreasing strength
3. Increase slump

E. Superplasticizer (high-range water-reducing)

(NOTE: Superplasticizers are super-water-reducing admixtures capable of increasing workability and flowability without causing air entrainment or retarding set. Sulfonated melamine formaldehyde condensates and sulfonated naphthalene formaldehyde condensates are used as superplasticizers.)

1. Greatly reduce quantity of mix water needed
2. Increase workability without decreasing strength
3. Increase slump

F. Pozzolan

EXAMPLES: Natural materials such as diatomaceous earth, opaline cherts and shales, tuffs and pumicites; artificial materials such as fly ash

1. Improve workability
2. Improve plasticity

G. Waterproofing and dampproofing

EXAMPLES: Stearate of calcium, aluminum, ammonium, or butyl; petroleum greases or oils; soluble chlorides

1. Decrease permeability

INFORMATION SHEET

2. Preserve designed strength

H. Pigment — Add color

(NOTE: Finely ground pure mineral oxides are added to concrete to produce colored hardened concretes that create decorative effects, reduce glare, and mark highways, aisles and hazardous areas in industrial plants, and underground utilities.)

I. Fiber reinforcement

(NOTE: Strictly speaking, both plastic- and steel-fiber strand reinforcement should not be classified as additives; they are actually used as alternatives to wire-fabric reinforcement. However, since both types of fiber reinforcement are added during mixing, fiber reinforcement has been listed here.)

1. Reduce surface cracking

2. Increase strength

3. Decrease permeability

CONCRETE MATERIALS
UNIT I

ASSIGNMENT SHEET #1 — COMPARE BENEFITS AND COSTS OF USING ADMIXTURES

NAME _____ SCORE _____

Quality concrete can usually be obtained most economically by using quality ingredients in the basic mix: dry, free-flowing cement; clean water; and strong, well-graded aggregates. Sometimes, though, special concrete properties are required to decrease or extend the time of set, accelerate the rate of early strength development, etc. Then it may be desirable to use an admixture in the mix. When possible, however, a comparison should be made between the cost of changing the basic mix and the additional costs of using an admixture.

Obtain permission to visit a batch plant where concrete containing admixtures is being mixed. Interview personnel and, on the blanks below and on the next page, write a short report comparing the cost of changing the basic mix with the additional cost of using an admixture. The comparison should include, in addition to the cost of the admixture, any effect the use of the admixture will have on the cost of transporting, placing, finishing, curing, and protecting the concrete.

ASSIGNMENT SHEET #1

CONCRETE MATERIALS
UNIT I

ANSWERS TO ASSIGNMENT SHEET #1

Evaluated to the satisfaction of the instructor.

CONCRETE MATERIALS
UNIT I

TEST

NAME _____ SCORE _____

1. Match terms and definitions associated with concrete materials. Read each term or definition below and write an "X" beside the most correct answer.

   a. **Concrete**

      _____1. Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized

      _____2. Building material made by mixing cement, water, and aggregates

      _____3. Type of finely ground cement

   b. **Cement**

      _____1. Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized

      _____2. Building material made by mixing cement, water, and aggregates

      _____3. Filler material used in concrete to provide volume at low cost

   c. **Aggregate**

      _____1. To cause to stick together

      _____2. Type of finely ground cement

      _____3. Filler material used in concrete to provide volume at low cost

   d. **Bind**

      _____1. To cause to stick together

      _____2. To provide volume at low cost

      _____3. To cause cement powder to settle

   e. **Setting time**

      _____1. Time required for cement powder to settle

      _____2. Time required for concrete to become firm or solid

      _____3. Time required for concrete to become approximately cube-shaped

f. **Cuboid**

_____1. Approximately cube-shaped

_____2. Causing to stick together

_____3. Firm or solid

g. Degree to which liquids or gases are capable of passing through a substance

_____1. Plasticity

_____2. Workabilty

_____3. Permeability

h. Material that when combined with moisture will react with calcium hydroxide at ordinary temperatures to form compounds possessing properties of cement

_____1. Admixture

_____2. Pozzolan

_____3. Slump

i. Ease with which concrete can be placed, consolidated, and finished

_____1. Workability

_____2. Plasticity

_____3. Permeability

j. Agent added to concrete mix immediately before and during mixing to alter one or more concrete characteristic

_____1. Pozzolan

_____2. Admixture

_____3. Slump

k. Capacity for being flexible or workable

_____1. Workability

_____2. Plasticity

_____3. Permeability

TEST

l. Measure of consistency of freshly mixed concrete

_____1. Slump

_____2. Plasticity

_____3. Workability

m. Emergence of mixing water on the surface of newly placed concrete; caused by settling of solid materials within the mass

_____1. Pozzolan

_____2. Slump

_____3. Bleeding

2. Select from the following list basic raw materials used in portland cement. Place an "X" in the correct blanks.

_____a. Sand

_____b. Iron ore

_____c. Alumina

_____d. Crushed stone

_____e. Gypsum

_____f. Lime

_____g. Gravel

_____h. Silica

3. List three of the most common types of portland cement and how they are used.

a. _____

_____

b. _____

_____

c. _____

_____

TEST

4. Name properties of cement suitable for use as an ingredient in concrete.

   a. _____

   b. _____

5. State properties of water suitable for use as an ingredient in concrete.

   a. _____

   b. _____

6. Briefly discuss the importance of proper water-cement ratio.

   a. _____

   b. _____

7. Briefly discuss the effects of using impure water in concrete.

   a. _____

   b. _____

   c. _____

   d. _____

8. State three properties of aggregates suitable for use as an ingredient in concrete.

   a. _____

   b. _____

   c. _____

9. State categories of aggregate sizes and their definitions.

   a. _____

   _____

   b. _____

   _____

10. List classes of artificial aggregates and two materials used in each class.

    a. 1) Class _____

       2) Materials _____

CONCRETE MATERIALS
UNIT I

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 3
   d. 1
   e. 2
   f. 1
   g. 3
   h. 2
   i. 1
   j. 2
   k. 2
   l. 1
   m. 3

2. b, c, e, f, h

3. Answer should include any three of the following.

   a. Type I — Normal portland cement; general purpose
   b. Type II — Modified portland cement for moderate sulfur resistance, lower heat of hydration; generally used for massive construction
   c. Type III — High-early-strength cement; used when high strength at an early age is desired
   d. Type IV — Low-heat portland cement; used where rate of heat must be kept at a minimum, necessary only in massive construction
   e. Type V — Sulfate-resistant portland cement; used only in construction that is exposed to severe sulfate action
   f. White portland cement — Pure white-colored cement; generally used for architectural purposes

4. Answer should include the following.

   a. Dry and free-flowing
   b. Free of lumps

5. Answer should include the following.

   a. Tasteless and odorless
   b. Clean and free of impurities

6. Discussion should include the following.

   a. Total amount of water mixed with the cement determines quality of paste
   b. Water-cement ratio and the extent of chemical reactions between the cement and the water govern quality of the hardened paste

ANSWERS TO TEST

7. Discussion should include the following.

   a. Reduces cement's bonding ability
   b. Affects concrete's setting time
   c. Stains concrete
   d. Corrodes steel used as reinforcing material

8. Answer should include any three of the following.

   a. Well-graded
   b. Clean and free from fine dust, silt, loam, clay, or vegetable matter
   c. Abrasion-resistant
   d. Freeze/thaw-resistant
   e. Approximately cuboid
   f. Hard and durable

9. Answer should include the following.

   a. Fine — Aggregate containing particles ranging in size from very fine up to 1/4 inch
   b. Coarse — Aggregate containing particles ranging in size from 1/4 inch up to the largest size that can be used on a job

10. a. 1) Class — Ultra-lightweight
    2) Materials (Answer should include any two of the following.)
    Vermiculite, expanded glass, ceramic spheres, carbonized cereals, expanded plastics, perlite

    b. 1) Class — Lightweight
    2) Materials (Answer should include any two of the following.)
    Expanded clay, expanded shale, expanded slate, sintered fly ash, expanded slag, furnace clinker, crushed brick, petroleum coke

    c. 1) Class — Normal-weight
    2) Materials (Answer should include any two of the following.)
    Iron slag, glass frits, calcined bauxite, compacted cement

    d. 1) Class — Heavyweight
    2) Materials (Answer should include any two of the following.)
    Steel or iron shot, steel or iron pellets, steel or iron punchings

11. Answer should include one function for each of the following admixture classes.

    a. Air-entraining
       1) Improve durability
       2) Increase workability
       3) Reduce bleeding

ANSWERS TO TEST

b. Retarding
   1) Delay setting time
   2) Offset adverse high-temperature weather conditions

c. Accelerating
   1) Speed setting time
   2) Speed early-strength development
   3) Offset adverse low-temperature weather conditions

d. Superplasticizer (high-range water-reducing)
   1) Greatly reduce quantity of mix water needed
   2) Increase workability without decreasing strength
   3) Increase slump

e. Pozzolan
   1) Improve workability
   2) Improve plasticity

f. Water-reducing
   1) Reduce quantity of mix water needed for a given consistency
   2) Increase workability without decreasing strength
   3) Increase slump

g. Waterproofing and dampproofing
   1) Decrease permeability
   2) Preserve designed strength

h. Pigment — Add color

i. Fiber reinforcement
   1) Reduce surface cracking
   2) Increase strength
   3) Decrease permeability

CONCRETE TOOLS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to match the correct tools to their uses and demonstrate proper care and safe use of the tools. The student will show this ability by completing assignment sheet and unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with concrete forming tools.
2. State rules for care and safe use of hand tools.
3. Match types of hammers to their correct uses.
4. Match types of saws to their correct uses.
5. Match types of squares to their correct uses.
6. Match types of measuring tools to their correct uses.
7. Match types of leveling instruments to their correct uses.
8. Match miscellaneous hand tools and equipment to their correct uses.
9. Match terms and definitions associated with concrete finishing tools.
10. State specific uses of hand tools used for placing and finishing fresh concrete.
11. Identify hand tools used for placing and finishing fresh concrete.
12. Label hand tools used for patching and mixing concrete.
13. Label hand tools used for working with hardened concrete.
14. Match terms and definitions associated with concrete power tools.
15. State safety rules pertaining to power tools.
16. Select from a list guidelines for proper care of power tools.
17. State general uses of power tools used for placing and finishing fresh concrete.
18. Identify types of power tools used for placing and finishing fresh concrete.

OBJECTIVE SHEET

19. State general uses of sprayers.
20. Identify types of sprayers.
21. State general uses of power saws.
22. Identify types of power saws.
23. Match types of power grinders to their specific uses.
24. Identify types of power grinders.
25. Complete a safety test pertaining to power tools.

CONCRETE TOOLS
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Supplement #1 — Hand Tools Crossword Puzzle

Supplement #2 — Power Tools Crossword Puzzle

D. Information sheet

E. Assignment Sheet #1 — Complete a Safety Test Pertaining to Power Tools

F. Answers to assignment sheet

G. Test

(NOTE: Because of the length of this unit we recommend that the test be given in three parts; Part I—objectives 1 through 8, Part II—objectives 9 through 13; Part III—objectives 14 through 25.)

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Audiovisual presentations

(NOTE: Presentations "a" through "g" are available from the Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 6007. Presentation "d" is also available from the American Concrete Institute, P.O. Box 19150, Redford Station, Detroit, Michigan 48219.)

a. *Concrete Tools and Finishing*. 50 slides, Portland Cement Association, n.d.; order number 55006.

(NOTE: This slide set demonstrates the fundamental requirements of finishing concrete slabs on ground and includes basic tools, finishing techniques, and methods of obtaining special finishes.)

b. *Quality Concrete Slide Reference File III*. 362 color slides, Portland Cement Association, 1980.

(NOTE: This slide set includes 15 individual chapters or groups of slides, any one of which may be purchased separately. These slides illustrate typical tools, equipment, and techniques used to produce quality concrete.)

SUGGESTED ACTIVITES

Tampers

- Display as many tampers as possible for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all tampers: to embed coarse aggregate just below concrete surface and to consolidate surface. Stress that tampers are used only on low-slump concrete.
- Demonstrate uses of various types of tampers, pointing out that jitterbugs and rollerbugs should be used only on low-slump (1 inch or less) concrete and that hand tampers, which are seldom used, are only used on very stiff (no slump)concrete.
- Demonstrate the use of each type of tamper you have displayed, and then let the students repeat the demonstration so that they may "get the feel" of the various tampers. Caution students not to overwork the concrete when using a tamper.
- Observe student demonstrations and correct procedures as necessary.

Edgers

- Display as many of the various types and sizes of edgers as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all edgers: to form a radius at concrete slab edges to improve appearance and reduce risk of damage to edges.
- Demonstrate how to use an edger. Have students practice the procedures. Observe students and correct procedures as necessary.

Jointers

- Display as many of the various types and sizes of jointers (groovers) as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all jointers: to cut joints partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance.
- Demonstrate the use of each type of jointer you have displayed, and then let the students repeat the demonstrations so that they may "get the feel" of the various jointers.
- Observe student demonstrations and correct procedures as necessary.

SUGGESTED ACTIVITIES

c. Masonry Specialty Company, 4430 Gibsonia Road, Gibsonia, Pennsylvania 15400

3. Samples of all the tools and equipment to be discussed in conjunction with this unit

4. Materials needed for tool demonstrations

5. Accident report forms

6. Newspaper clippings or case studies that relate to forming-tool use

C. Introduce unit.

- Display samples of tools and equipment needed for form setting. Discuss the different tools and their uses.

- Discuss hand tools, pointing out the importance of buying good grades of tools. Tell students that quality, not price, should be their main concern when purchasing tools. Also warn students that there are many different types and styles of each kind of tool and that there are specialized tools for specific jobs and uses. Impress on students that they should not run right out and purchase a bunch of tools without really knowing what tools they will be using on the job.

- Display tool catalogs for students to review.

- Tour a construction site where concrete masons are setting forms and finishing concrete. Relate tools illustrated in this unit to the ones being used on the job.

- Emphasize the convenience of power tools over hand tools; stress the greater need for safety procedures when using power tools.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing the care and safe use of tools.

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with forming tools, showing samples of tools and materials when appropriate to illustrate terms.

2. Use Information Sheet, Section II, to discuss rules for care and safe use of hand tools.

- Explain the importance of buying quality tools. Explain how good care will preserve the tools so that they will last for many years.

SUGGESTED ACTIVITES

- Discuss how safe and proper use of tools will save tools and prevent accidents.
- Have students explain details of accidents they know of when someone used tools improperly.
- Discuss newspaper clippings or case studies that relate to improper use of tools.
- Demonstrate to students how to clean and store tools properly.
- Demonstrate how the quality and quantity of work increases when using sharp tools in good condition compared to using dull tools in poor condition.
- Explain your policy for replacement and repair of damaged tools.
- Outline your tool-management system for shop and job site.
- Explain that dropping and bumping a small leveling instrument such as the spirit, torpedo, or line level can effect its accuracy. Further explain that the water level is probably the least likely to be damaged when being handled.

3. Use Information Sheet, Section III, to discuss types of hammers and their correct uses.
   - Display samples of the actual hammers used to set forms.
   - Discuss the different uses of these hammers, and explain why they are used for those specific jobs.
   - Have students practice using hammers by nailing scrap boards together, then pulling the nails back out.
4. Use Information Sheet, Section IV, to discuss types of saws and their correct uses.
   - Display samples of the actual saws discussed in this section of the information sheet.
   - Discuss proper use of each saw, and allow the students to handle and examine each saw.
   - Demonstrate making a straight cut with each saw.
   - Caution students against mishandling saws, and discuss the damage that can be done to the saws and to the workpiece if the saw is mishandled. Have students consider the expense of repairing or replacing tools.
   - Explain to the students how saw blades are sharpened.

SUGGESTED ACTIVITIES

- Demonstrate correct procedures for replacing a blade in the hacksaw frame and the proper way the blade goes into the frame so that the teeth on the blade point away from the handle.

5. Use Information Sheet, Section V, to discuss types of squares and their correct uses.

   - Display samples of the actual squares discussed in this section of the information sheet.
   - Allow students to handle and examine the squares.
   - Discuss proper use of each square.
   - Caution students about careful handling of the squares, explaining that squares are accurate instruments and if damaged they are no good to the craftsman.

6. Use Information Sheet, Section VI, to discuss types of measuring tools and their correct uses.

   - Display samples of the actual measuring tools discussed in this section of the information sheet. You may want to show students different rules and tapes that you have available.

     EXAMPLES: Folding rules—6-foot and 8-foot; steel tapes in various lengths—6-foot, 8-foot, 12-foot, 20-foot, 25-foot, 50-foot, and 100-foot

   - Discuss proper use of rules and tapes.
   - Caution students about keeping the joints on their folding rules oiled and clean so that the rules will operate efficiently and are less liable to break.
   - Caution students about kinking their steel tapes: kinking steel tapes causes weak places in the tapes that will break.
   - Stress the importance of proper care of tapes. Explain that improper care can cause inaccurate measurements. Suggest that students clean tapes and apply a thick coat of oil before winding tapes back into their cases.

7. Use Information Sheet, Section VII, to discuss types of leveling instruments and their correct uses.

   - Display samples of the leveling instruments illustrated in this section of the information sheet.
   - Demonstrate and discuss the proper use of each of the levels referred to in this section of the information sheet.

SUGGESTED ACTIVITES

8. Use Information Sheet, Section VIII, to discuss uses of miscellaneous hand tools and equipment.

   - Display samples of the various hand tools discussed in this section of the information sheet. Allow students to handle and examine each tool.
   - Discuss and demonstrate proper use of each of these tools.
   - Have students practice using these tools.
   - Set up contests to determine which students can use hand tools safely, quickly, and accurately.

9. Use Information Sheet, Section IX, to discuss terms and definitions associated with concrete finishing tools.

   - Discuss and demonstrate terms that may be unfamiliar to the students.
   - Provide actual samples when possible.

10. Use Information Sheet, Sections X and XI, to discuss types of hand tools used for placing and finishing fresh concrete and their specific uses.

    - Show one of the following audiovisual presentations: *Concrete Tools and Finishing, Finishing and Curing Quality Concrete*, or *Finishing Concrete Flatwork*. Then discuss each type of tool listed below.

    Shovels

    - Display common shovels for students to identify and become familiar with.
    - Explain and demonstrate how concrete is placed and puddled with a shovel. Then let students repeat the demonstration.
    - Observe and correct student demonstrations as necessary.

    Straightedges

    - Display as many straightedges as practical for the students to identify and become familiar with.
    - Explain and promote discussion of the specific use of all straightedges: to rod concrete surface to a given grade.
    - Demonstrate the use of each type of straightedge, and then let the students repeat the demonstrations so that they may "get the feel" of the various types.
    - Observe the student demonstrations and correct procedures as necessary.

SUGGESTED ACTIVITIES

Darbies

- Display as many darbies as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all darbies: to darby concrete surface to eliminate any high or low spots left after the rodding process.
- Demonstrate the use of each type of darby you have displayed, and then let the students repeat the demonstrations.
- Observe student demonstrations and correct procedures as necessary.

Bullfloats

- Display as many bullfloats as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all bullfloats: to float large concrete surfaces to eliminate any high or low spots or ridges left after the rodding process.
- Explain the use of each type of bullfloat.
  - —Explain that if all bleeding has ceased, a magnesium or aluminum bullfloat will tend to seal the surface of lightweight, air-entrained concrete. Sealing the surface can be a good factor on hot, dry, windy days when the concrete may set too fast otherwise.
  - —Explain how wood bullfloats tend to open the surface of non-air-entrained concrete, which can be a good factor on cool days when the concrete may set too slowly otherwise.
  - —Demonstrate how to use a bullfloat, showing students how the bullfloat handle will need to be lowered to raise the leading edge of the bullfloat on the forward stroke and then raised to raise the leading edge on the backward stroke. Also explain that, when possible, bullfloating should be done perpendicular to the direction of the straightedging process. If bullfloating in the same direction as the straightedging process, the bullfloat tends to dish into the concrete surface, but bullfloating perpendicular to the straightedging process will flatten any ridges that were left by the straigthedge.

    (NOTE: You may want to demonstrate the use of the bullfloat on wet sand rather than on fresh concrete. Even though the wet sand will not act exactly like fresh concrete, it is a good substitute for fresh concrete and is certainly much more economical to use for demonstration and practice.)
  - —Caution students to stay alert when using a bullfloat. The bullfloat has a long handle, so everyone and everything behind the student must be clear before using the bullfloat. Also caution students to use only OSHA-approved bullfloats with insulated handles.

SUGGESTED ACTIVITES

Tampers

- Display as many tampers as possible for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all tampers: to embed coarse aggregate just below concrete surface and to consolidate surface. Stress that tampers are used only on low-slump concrete.
- Demonstrate uses of various types of tampers, pointing out that jitterbugs and rollerbugs should be used only on low-slump (1 inch or less) concrete and that hand tampers, which are seldom used, are only used on very stiff (no slump)concrete.
- Demonstrate the use of each type of tamper you have displayed, and then let the students repeat the demonstration so that they may "get the feel" of the various tampers. Caution students not to overwork the concrete when using a tamper.
- Observe student demonstrations and correct procedures as necessary.

Edgers

- Display as many of the various types and sizes of edgers as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all edgers: to form a radius at concrete slab edges to improve appearance and reduce risk of damage to edges.
- Demonstrate how to use an edger. Have students practice the procedures. Observe students and correct procedures as necessary.

Jointers

- Display as many of the various types and sizes of jointers (groovers) as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all jointers: to cut joints partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance.
- Demonstrate the use of each type of jointer you have displayed, and then let the students repeat the demonstrations so that they may "get the feel" of the various jointers.
- Observe student demonstrations and correct procedures as necessary.

SUGGESTED ACTIVITIES

Hand floats

- Display as many of the various types and sizes of hand floats as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use for all hand floats: to float concrete around hard-to-reach places and to prepare concrete surface for troweling.
- Discuss the different types of materials used to make hand floats.

  EXAMPLES: Redwood, teak, white pine, mahogany, yellow poplar, laminated canvas-resin, aluminum, magnesium, steel, cork, sponge rubber, and carpet

- Discuss the use of each type of hand float.

  —Wood, magnesium, aluminum, and steel floats are used on floor slabs to finish fresh concrete.

  —Cork, rubber, and carpet floats are usually used on vertical surfaces to finish concrete. Each of the different soft-faced floats creates a different finished texture on the concrete.

- Demonstrate the use of a hand float.
- Allow students to practice wing hand floats. Observe students and correct procedures as necessary.

Trowels

- Display as many of the various types of hand trowels as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all hand trowels: to give concrete surface a dense, smooth finish.
- Discuss the use of the various types of trowels.

  —Finishing trowels are used to lay down and finish concrete. Larger, wider trowels are used on wet concrete.

  —Fresno trowels are used for lay-down work and in hard-to-reach areas.

  —Midget trowels are used on small areas such as window sills, curbs, walls, steps, and such.

  —Pipe trowels are used around pipes, forms, and equipment where other trowels will not fit.

- Demonstrate the use of a finishing trowel.
- Allow students to practice using finishing trowels. Observe students and correct procedures as necessary.

SUGGESTED ACTIVITES

Combination tools

- Display as many of the various types of combination tools as practical for the students to identify and become familiar with.

- Discuss the various types of combination tools, and then give each student a set of tools and the descriptive name of the set. Have students demonstrate how they think the tool should be used. If they use the tool incorrectly, stop them, and then show students the proper use of the too.

  EXAMPLE: Hand a student a cove-and-base tool set and ask him or her to attempt to use it. If the student is unable to use it correctly, stop him or her and explain that the tool should ride with one side on the floor and the other side on the base. When the mortar is applied, the tool will form the base and the cove at the same time. The spoon is used to help form the corners where the base tool will not work, and it is also used to wipe out any blemishes that may occur on the base after the final finishing.

- Demonstrate the use of each of the combination tools, and then let the students repeat the demonstration.

- Observe student demonstrations and correct procedures as necessary.

11. Use Information Sheet, Sections XII and XIII, to discuss hand tools used for patching and mixing concrete, and for working with hardened concrete.

    - Display the various types of tools illustrated in these sections of the information sheet.

    - Discuss their general uses, and then demonstrate their uses.

    - During demonstrations, give the students any pertinent information they may need to know about specific tools.

      EXAMPLES: Explain how the different grit sizes on rubbing stones will produce a different texture on the surface of the concrete. Caution students about premature rubbing of the concrete because if the concrete has not set long enough, the stone will loosen and pull out the surface aggregate and the protective surface of the concrete.

12. Display selected tools from all the sections of the information sheet and label each with a letter of the alphabet. Have each of the students see how many of the tools they are able to identify and explain how to use.

13. Have students complete Supplement #1, "Hand Tools Crossword Puzzle."

14. Use Information Sheet, Section XIV, to discuss terms and definitions associated with power tools.

SUGGESTED ACTIVITIES

15. Use Information Sheet, Sections XV and XVI, to discuss guidelines for proper care of power tools and safety rules pertaining to power tools.

    - Discuss safety rules pertaining to power tools and guidelines for proper care of power tools.
    - Demonstrate proper care of power tools.
    - Display examples of power tools that have been improperly cared for or abused.
    - Discuss Assignment Sheet #1, "Complete a Safety Test Pertaining to Power Tools." Indicate that students must make 100 percent on this assignment sheet before they will be allowed to use power tools.
    - Explain your class and job-site policies for the use of power tools.
    - Review accident-report forms with students.
    - Caution students not to fill the gas tank of a gasoline-powered tool while the machine is running.
    - Caution students not to run gasoline-powered tools indoors unless adequate ventilation has been provided.
    - Have students complete Assignment Sheet #1.

16. Use Information Sheet, Sections XVII and XVIII, to discuss uses of power tools used for placing and finishing fresh concrete.

    - Display as many of the power straightedges illustrated in the information sheet as possible.
    - Discuss general uses of power straightedges, and then discuss the specific uses of each type.
    - Demonstrate the proper handling of power straightedges. During the demonstration, caution students not to strain their backs as they are bending over and pulling great amounts of concrete with the straightedge. Show students the proper procedure of working with a shovel person when straightedging.
    - Take a field trip to a construction site where students can watch concrete masons using power straightedges. Direct students to watch closely the technique the masons handling the straightedges and the people handling the shovels use when working together during the power straightedging process.
    - Allow students to demonstrate proper handling of power straightedges. Observe student demonstrations and correct procedures as necessary.
    - Display as many of the power tampers illustrated in the information sheet as possible.

SUGGESTED ACTIVITES

- Discuss general uses of tampers, and then discuss the specific uses of each type of tamper.

- Explain to students that power tampers are not furnished on many jobs, but that students should learn their use and become familiar with handling them just in case they are asked to use them.

- Demonstrate the proper handling of power tampers, explaining that tampers are used much the same way as are bullfloats.

- Allow students to demonstrate proper handling of power tampers. Observe demonstrations and correct procedures as necessary.

- Display as many of the power floats and finishing machines illustrated in the information sheet as possible.

- Discuss general uses of power floats and finishing machines, and then discuss the specific uses of each type of machine.

- Show students how to install the float blades on a trowel machine, and point out the various types of float blades that may be used on trowel machines.

- Demonstrate the proper handling of power floats and finishing machines.

  —Caution students not to get too close to objects or edges with trowel machines and floats.

  —Show students how to move the machines to the left and right: gently raise up on the machine's handle to move it to the left, gently lower the machine's handle to move it to the right.

  —Show students that when floating and troweling, it is best to work at right angles to the bullfloating process. Also demonstrate how each successive floating or troweling process should be made at right angles to the previous process.

  —Demonstrate the back-and-forth pattern followed across the slab when using power floats and finishing machines, and show students how to overlap passes by about one-half the width of the blade.

- Allow students to demonstrate proper handling of the machines. Observe student demonstrations and correct procedures as necessary.

17. Use Information Sheet, Sections XIX and XX, to discuss the types of sprayers and their uses.

- Display as many of the sprayers illustrated in the information sheet as possible.

SUGGESTED ACTIVITIES

- Discuss general uses of sprayers.
- Discuss specific uses of each type of sprayer.
- Demonstrate the proper handling of sprayers. Caution students not to use different types of liquids in the sprayers unless they clean the sprayer thoroughly before each new use—which should always be done anyway.
- Allow students to demonstrate proper use of the sprayers. Observe student demonstrations and correct procedures as necessary.

18. Use Information Sheet, Sections XXI and XXII, to discuss the types of power saws and their uses.
    - Display as many of the power saws illustrated in the information sheet as possible.
    - Discuss general uses of power saws, and then discuss specific uses of each type of saw.
    - Demonstrate the proper handling of power saws. Caution students to keep their feet away from the saw blades.
    - Allow students to demonstrate proper handling of the saws. Observe student demonstrations and correct procedures as necessary.
19. Use Information Sheet, Sections XXIII and XXIV, to discuss the types of power grinders and their uses.
    - Display as many of the power grinders illustrated in the information sheet as possible.
    - Discuss general uses of power grinders, and then discuss specific uses of each type of grinder.
    - Stress the importance of wearing safety equipment when working with power grinders—especially when using grinders on walls and ceilings.

      EXAMPLES: Eye protection, hard hat, gloves, long-sleeved shirt, respirator
    - Caution students about using ceiling grinders around electrical wiring.
    - Caution students to be positive that other workers are not present when they are cutting nails off ceilings with a ceiling grinder.
    - Demonstrate the proper handling of power grinders.
    - Allow each student to demonstrate proper handling of the grinders. Observe student demonstrations and correct procedures as necessary.

H. Have students complete Supplement #2, "Power Tool Crossword Puzzle."

I. Give Test.

SUGGESTED ACTIVITIES

J. Critique test and discuss in class.

K. Reteach and retest if necessary.

L. Complete appropriate section of the competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

III. Unit references

A. *Austin Vibra-Tamp Cement Surfacing Machine*. Colton, California: Austin Brothers Manufacturing Co., Inc., n.d.

B. *The Bantom*. Paso Robles, California: Forshel Ltd., n.d.

C. *Champion Con-Trowel*. St. Louis, Missouri: Champion Manufacturing Company, n.d.

D. *EDCO Model E-6 Edge and Base Grinder*. Silver Spring, Maryland: Equipment Development Co., n.d.

E. *Goldblatt Tool Company Tool Catalog*. Kansas City, Kansas: Goldblatt Tool Company, n.d.

F. *Gomaco Finishing Machine Flier*. Ida Grove, Iowa: Gomaco Corporation, n.d.

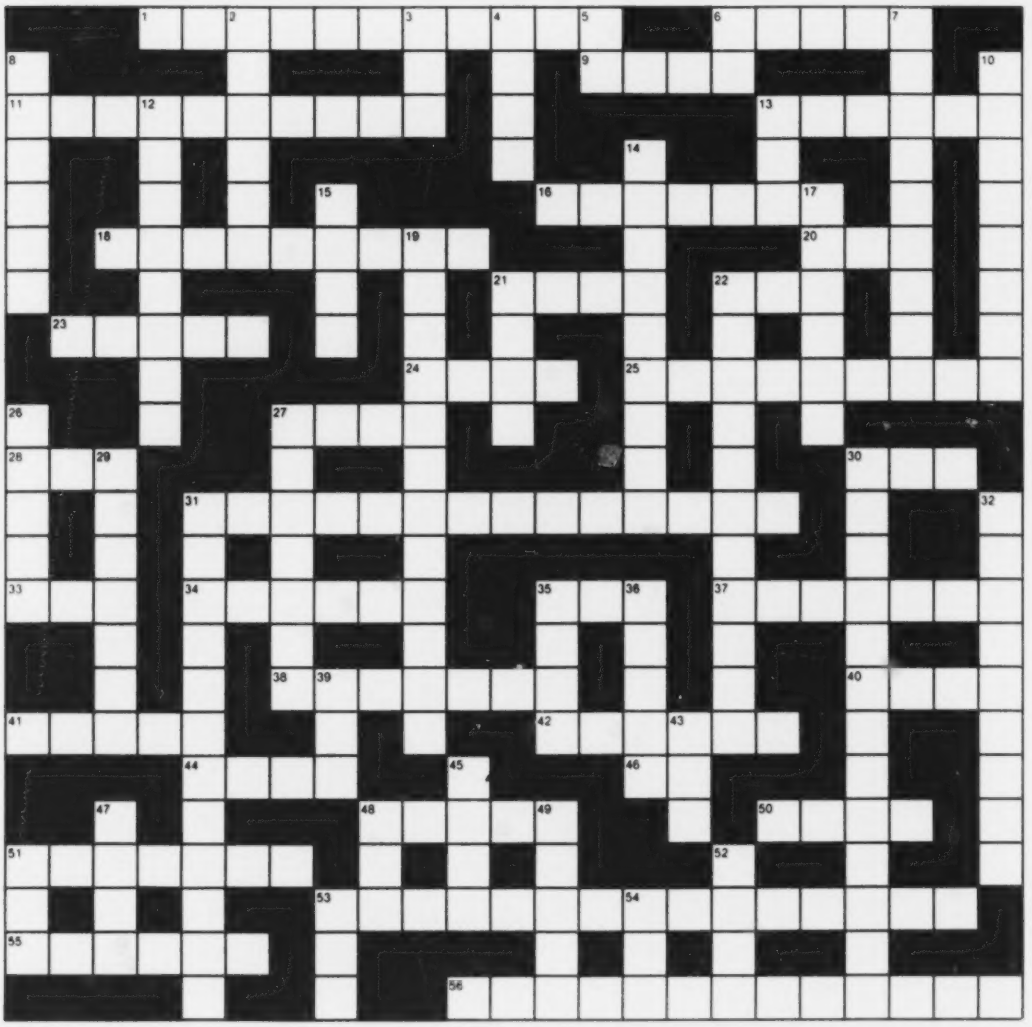
G. Hendrix, Laborn, J. "Bud." *Fundamentals of Concrete and Cement Masonry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

H. *Stow Manufacturing Company Concrete Equipment Catalog*. Binghamton, New York: Stow Manufacturing Company, n.d.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — HAND TOOLS CROSSWORD PUZZLE

Use the information sheet and the clues on the following page to complete the puzzle below.



SUPPLEMENT #1

ACROSS

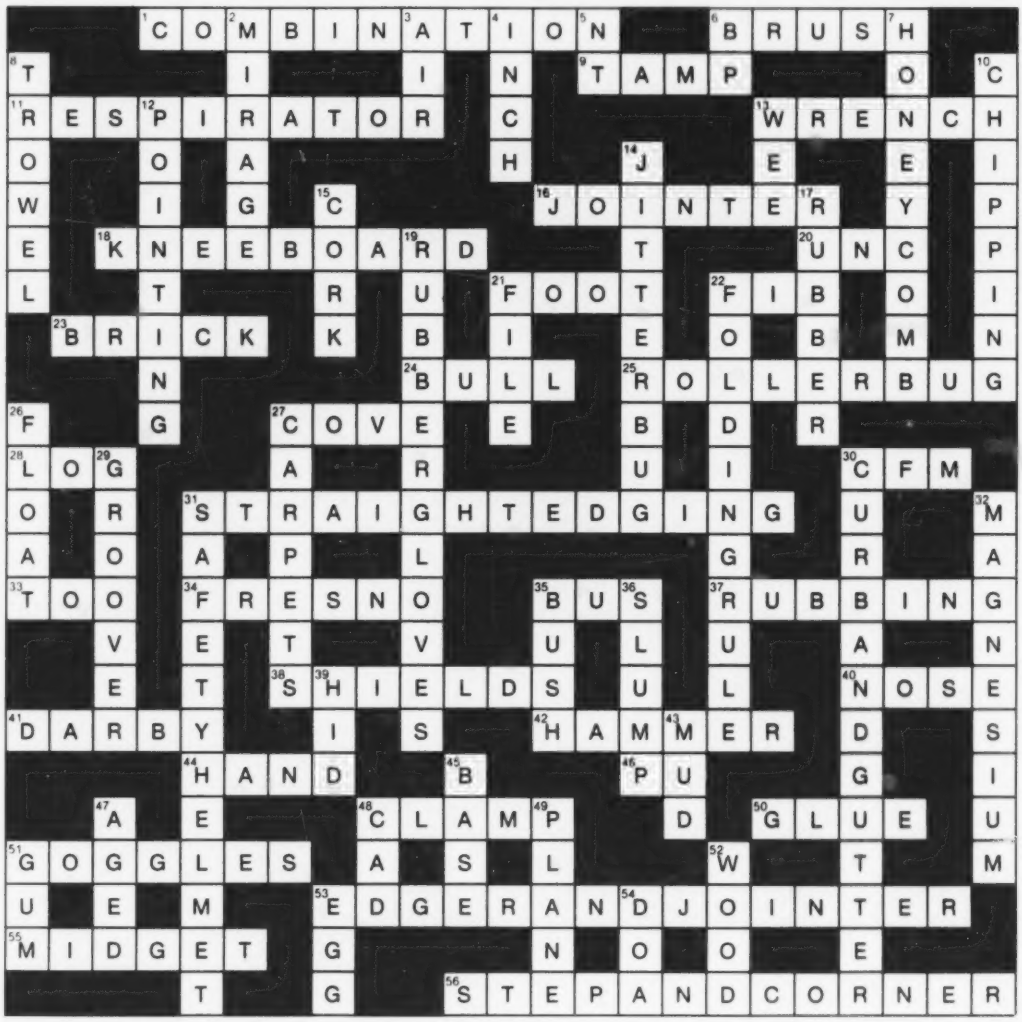
1. Type of tool designed to do at least two jobs
6. Tool used in finishing and rubbing operations
9. Tool used to consolidate very low-slump concrete
11. Equipment worn over nose and mouth to prevent inhalation of dusts or mists
13. Tool used for holding and turning nuts, bolts, pipes, etc.
16. Tool used to cut grooves in concrete
18. Equipment used to kneel on while finishing flatwork
20. Uncle (slang)
21. Twelve inches
22. Lie (slang)
23. Hard, red building material
24. Type of float used during process of leveling concrete to eliminate any high or low spots or ridges left after rodding process
25. Largest type of tamper
27. Concave or radius at bottom section of curb, step, or base
28. Cut section of tree trunk or limb
30. Abbrev. for cubic feet per minute
31. Process of rodding concrete surface to a given grade
33. Also
34. Type of trowel fitted with a long handle
35. Vehicle that can carry many passengers
37. Type of stone used to dress down hardened concrete surface
38. Transparent protective devices worn over the face
40. Organ of smell
41. Tool used to eliminate high or low spots or ridges left by rodding process
42. For example 10 down
44. Type of float used to prepare concrete surface for troweling
46. It stinks (slang)
48. Device used to hold work in place
50. Material used to stick things together
51. Type of eye protection
53. Combination tool used for edging and jointing
55. Type of trowel
56. Type of combination tool

DOWN

2. Optical illustion
3. Pneumatic power
4. One-twelfth of a foot
5. Abbrev. for "not there"
6. Abbrev. for "ball park"
7. Cavity or pit in concrete
8. For example 12 down
10. Type of hammer used to cut off projections on hardened concrete
12. Type of trowel used to patch holes, grout base, and clean other tools
13. Tiny
14. Type of tamper
15. Special type of float used to create special finishes on rubbed concrete
17. Another special type of float
19. Type of hand protection
21. Tool used to dress edges of trowel
22. Tool used for measuring
26. For examples 15 and 17 down
27. Materials used to make a special type of float used to create special finishes on rubbed concrete
29. Another term for "jointer"
30. Combination tool
31. Head protection
32. Metal used for certain floats
35. Type of hammer used to create a rough, colorful finish
36. Consistency of concrete
39. Past tense of "hide"
43. Wet earth
45. Bottom section of wall
47. Grew older
48. Abbrev. for cadmium
49. Tool used for shaving wood surface to make it smooth
51. Type of turpentine
52. Type of float
53. Typical American breakfast food
54. Abbrev. for "dead on arrival"

SUPPLEMENT #1

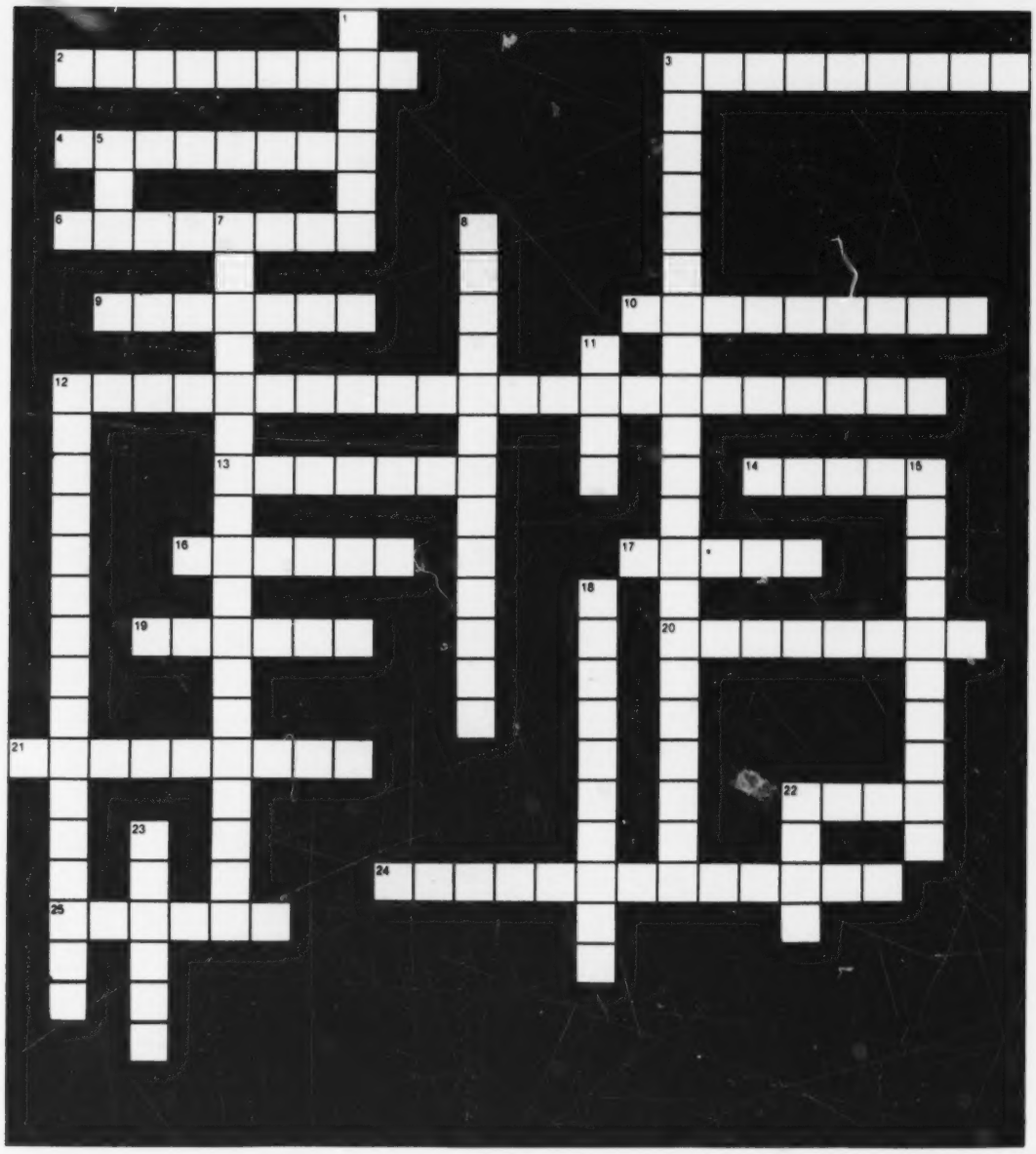
Solution to Puzzle


1 C O 2 M B I N 3 A T 4 I O 5 N 6 B R U S 7 H
8 T I I N 9 T A M P O 10 C
11 R E S 12 P I R A T O R C 13 W R E N C H
O O A H 14 J E E I
W I G 15 C 16 J O I N T E 17 R Y P
E 18 K N E E B O A 19 R D T 20 U N C P
L T R U 21 F O O T 22 F I B O I
23 B R I C K K B I E O B M N
N 24 B U L L 25 R O L L E R B U G
26 F G 27 C O V E E B D R
28 L O 29 G A R U I 30 C F M
O R 31 S T R A I G H T E D G I N G U 32 M
A O A P L G R A
33 T O O 34 F R E S N O 35 B U 36 S 37 R U B B I N G
V E T V U L U A N
E T 38 S 39 H I E L D S U L 40 N O S E
41 D A R B Y I S 42 H A M 43 M E R D S
44 H A N D 45 B 46 P U G I
47 A E 48 C L A M 49 P D 50 G L U E U
51 G O G G L E S A S L 52 W T M
U E M 53 E D G E R A N 54 D J O I N T E R
55 M I D G E T G N O O E
T G 56 S T E P A N D C O R N E R

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — POWER TOOL CROSSWORD PUZZLE

Use the information sheet and the clues on the following page to complete the puzzle below.



SUPPLEMENT #2

ACROSS

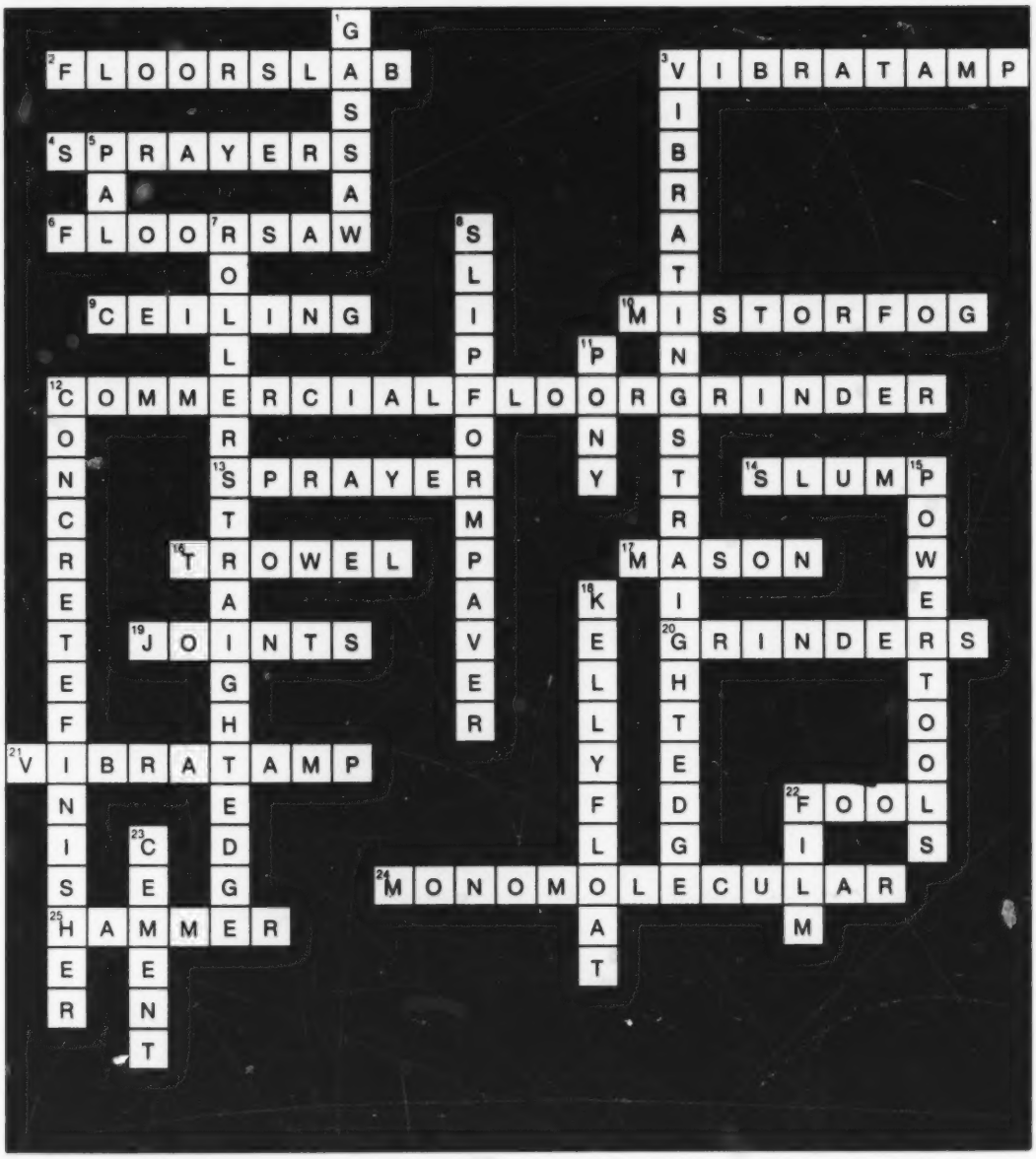
2. Any flat, horizontal concrete floor
3. Tool used on low-slump concrete to consolidate, level, and bring fines to concrete surface
4. Tools used to apply form oil, water, and curing compound to concrete surface
6. Type of medium-duty power saw
9. Type of grinder used to prepare ceiling for final finish
10. Forms of water sprayed on finished concrete until suitable curing can take place (3 words)
12. Type of power grinder (3 words)
13. Tool used to apply curing compounds on finished concrete
14. Consistency of fresh concrete
16. Tool used to finish concrete
17. Concrete _____
19. Cuts in concrete to regulate location of cracking or for decorative purposes
20. Tools used to remove seams and projections on walls and to rub and to finish walls
21. See #3 across
22. Person lacking in judgment; deranged person lacking in common powers of understanding
24. _____ film; compound sprayed on fresh concrete to reduce rapid evaporation
25. Hand tool used to drive and pull nails

DOWN

1. Type of portable saw *not* powered by electricity (2 words)
3. Type of heavy-duty straightedge (2 words)
5. Close friend—buddy
7. Type of power straightedge (2 words)
8. Type of power straightedge (2 words)
11. Type of finishing machine, a _____trowel
12. Type of large finishing machine used on pavement, bridges, parking areas, and airstrips (2 words)
15. Subject of this puzzle
18. Type of power float (2 words)
22. Monomolecular_____
23. Main ingredient of concrete

SUPPLEMENT #2

Solution to Puzzle



CONCRETE TOOLS
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with concrete forming tools

A. **Rip** — To saw wood with the grain

B. **Crosscut** — To saw wood across the grain

C. **Square** — To form a right angle; 90 degrees to a straight line

D. **Grade** — Given elevation to which forms are set

E. **Elevation** — Given grade

F. **Plumb bob** — Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface

G. **Leveling rod** — Pole with markings graduated upward from zero; used with leveling instrument to determine elevations

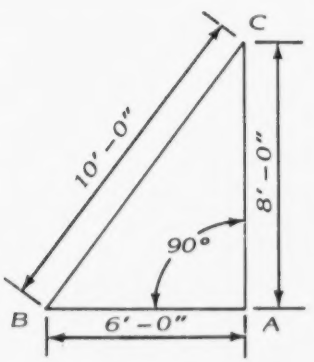
H. **Stake** — Pointed piece of wood or metal driven into ground and used to hold forms in place

I. **Soapstone** — Soft stone used for marking

J. **3-4-5 method** — Method of squaring a line by forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

EXAMPLE: Using 3-4-5 method to square building lines 6′ – 0″ × 8′ – 0″, Line BC will measure exactly 10 feet. See Figure 1.

FIGURE 1



INFORMATION SHEET

II. Rules for care and safe use of hand tools

A. Use the correct tool for the job

B. Keep tools clean

C. Maintain tools properly

D. Keep tools sharp when appropriate

E. Inspect tools frequently to make sure they are in good condition

F. Repair broken or damaged tools promptly

G. Dispose of broken tools that cannot be repaired

H. *Do not* use broken tools

I. *Do not* throw tools

J. Protect cutting edge of tools when carrying and storing

K. Store tools properly when not in use

(NOTE: *Do not* carry tools in your pocket; *do not* place tools where they can roll off; protect cutting edges; lightly oil tools before storing; store tools in a dry place.)

L. Wear eye, ear, and nose protection when appropriate

M. Stay alert when using hand tools

EXAMPLE: Keep fingers away from cutting edges; work away from your body when using cutting tools; be sure everyone is clear before you swing a sledgehammer; use tools with insulated or wood handles when working around electrical equipment.

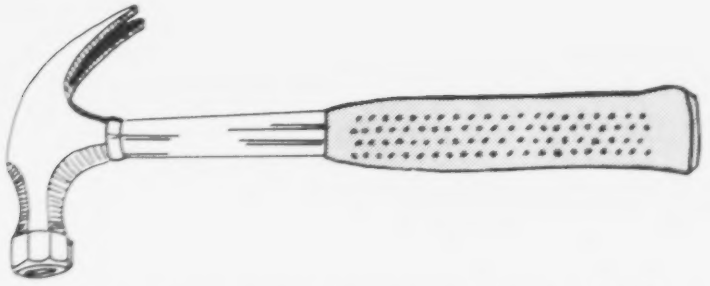
III. Uses of types of hammers (Figures 2-4)

A. Curved-claw hammer — Used to drive and pull nails

INFORMATION SHEET

EXAMPLE:

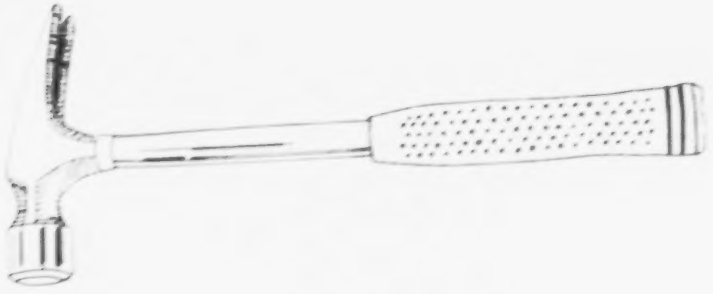
FIGURE 2



B. Straight-claw hammer — Used to drive nails, pull nails, dismantle, and wreck

EXAMPLE:

FIGURE 3

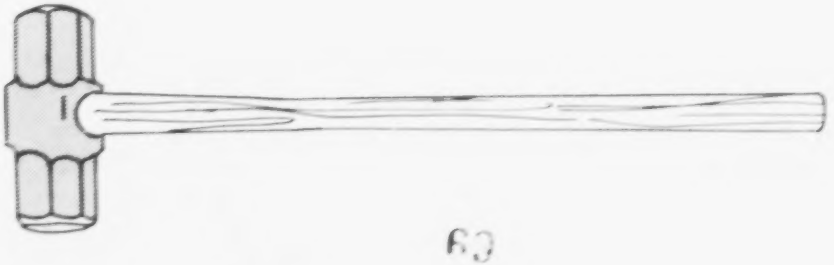


C. Sledgehammer — Used to drive stakes and break concrete

(NOTE: Sledgehammers used for forming operations weigh from 6 pounds to 12 pounds depending on the job they are to be used for.)

EXAMPLE:

FIGURE 4



INFORMATION SHEET

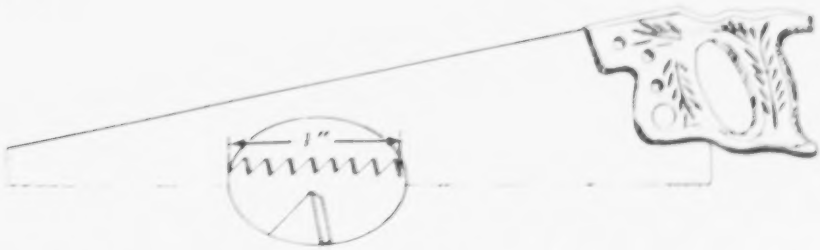
IV. Uses of types of saws (Figures 5-7)

A. Crosscut hand-saw — Used to cut across the grain of wood

(NOTE: Crosscut saws come in lengths of 20 inches to 26 inches with four to twelve points per inch; teeth are filed at an angle across the face. See Figure 5.)

EXAMPLE:

FIGURE 5



B. Rip hand-saw — Used to cut with the grain of wood

(NOTE: Ripsaws come in lengths of 20 inches to 28 inches with five to seven points per inch; teeth are filed square across the face. See Figure 6.)

EXAMPLE:

FIGURE 6

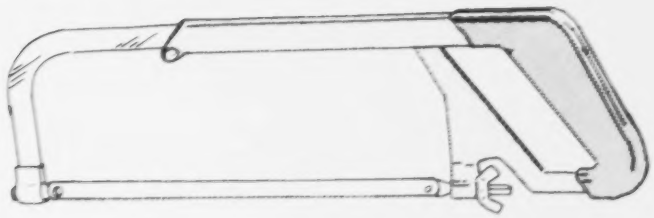
C. Hacksaw — Used to cut metal

(NOTE: Hacksaws have U-shaped frames and replaceable blades that come in lengths of 8 inches to 12 inches.)

INFORMATION SHEET

EXAMPLE:

FIGURE 7

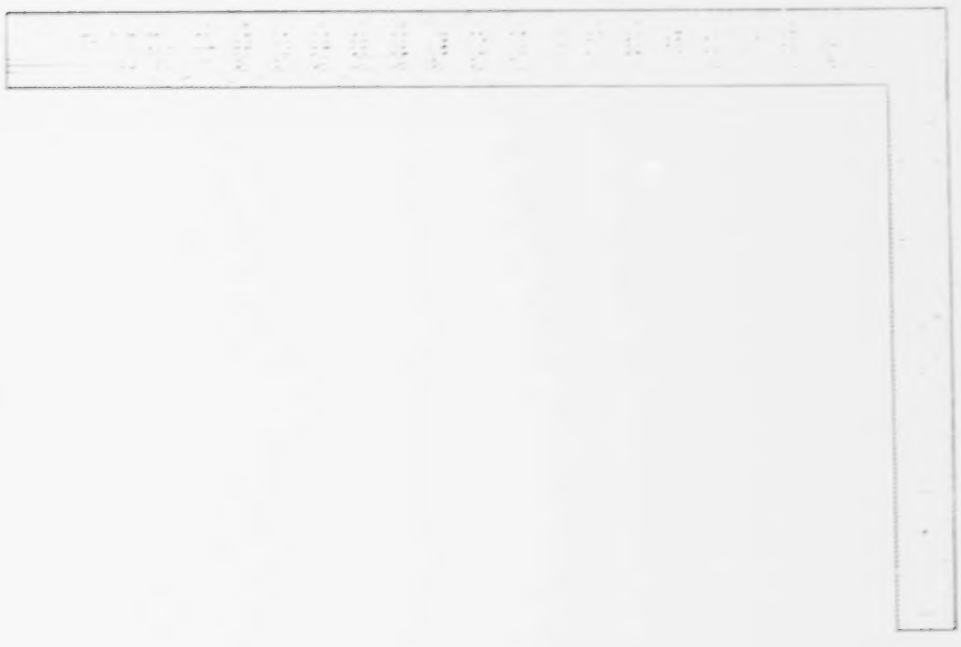


V. Uses of types of squares (Figures 8 and 9)

A. Framing square — Used to square corners, check squareness, and lay out 90-degree angles

EXAMPLE:

FIGURE 8

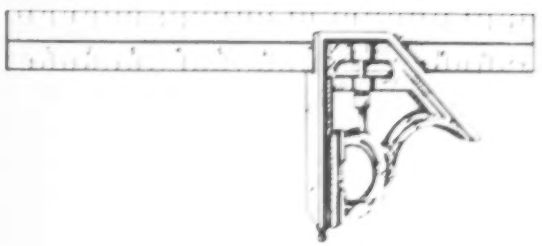


INFORMATION SHEET

B. Combination square — Used to check squareness and to lay out 45-degree angles

EXAMPLE:

FIGURE 9



VI. Uses of types of measuring tools (Figures 10-12)

A. Flexible steel tape — Used to measure irregular as well as regular shapes and to make accurate inside and outside measurements

(NOTE: Flexible steel tapes slide into a metal case. Most short tapes come in 6-foot to 25-foot lengths; long tapes come in 50-foot to 100-foot lengths. Both types of flexible steel tapes have a hook or loop on the end adjusted to true zero.)

EXAMPLES:

FIGURE 10

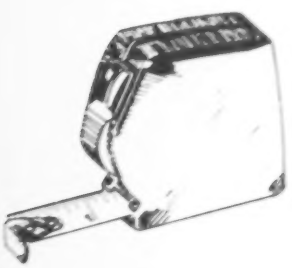
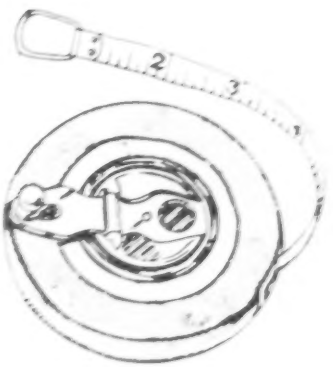


FIGURE 11

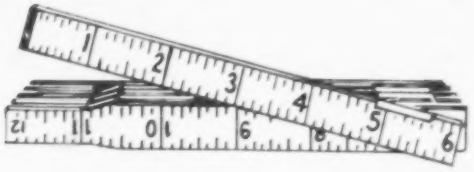


INFORMATION SHEET

B. Folding rule (zigzag rule) — Used to make accurate inside and outside measurements or laying out forms, laying out joints, and checking for square

EXAMPLE:

FIGURE 12



VII. Uses of types of leveling instruments (Figures 13-16)

A. Spirit level — Used to level forms and to transfer and check grades

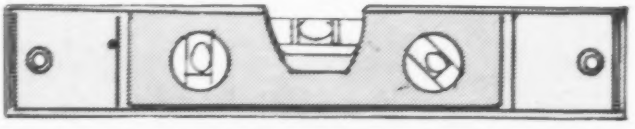
EXAMPLE:

FIGURE 13

B. Torpedo level — Used to check grades on short forms such as step treads

EXAMPLE:

FIGURE 14



C. Line level — Used to check grades of a dry line

EXAMPLE:

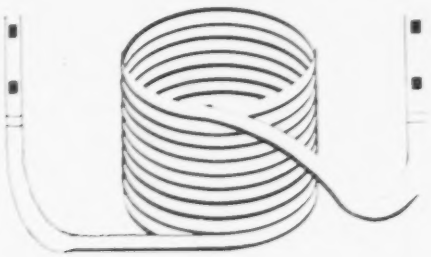
FIGURE 15

INFORMATION SHEET

D. Water level — Used to set and check elevations

EXAMPLE:

FIGURE 16



VIII. Uses of miscellaneous hand tools and equipment (Figures 17-30)

A. Line (string line; dry line) — Used as a guide to set stakes and forms straight and accurately

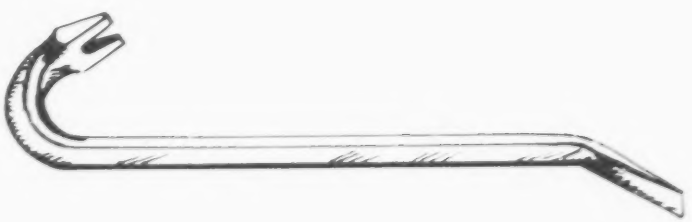
EXAMPLE:

FIGURE 17

B. Ripping bar (wrecking bar) — Used to pull nails, to pry, and to remove forms

EXAMPLE:

FIGURE 18

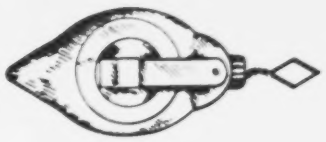


INFORMATION SHEET

C. Chalk box and line — Used to lay out work on concrete, to lay out cut lines on lumber, and to mark joints in concrete

EXAMPLE:

FIGURE 19



D. Magnetic nail driver — Used to drive short masonry nails through expansion material and into masonry wall when setting expansion material

EXAMPLE:

FIGURE 20

E. Utility knife — Used to cut expansion material

EXAMPLE:

FIGURE 21

F. Side-cut pliers — Used to cut and twist wires on reinforcing steel and on forms

EXAMPLE:

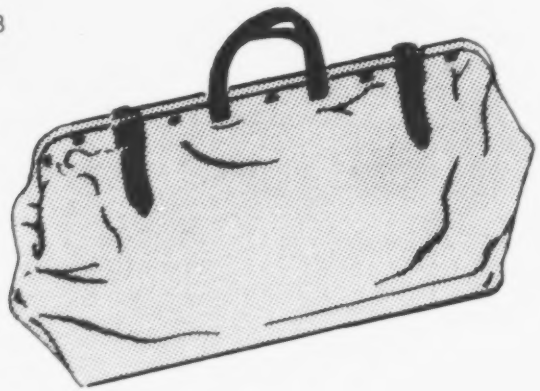
FIGURE 22

INFORMATION SHEET

G. Tool bag — Used to store and transport tools

EXAMPLE:

FIGURE 23



H. Push broom — Used to finish fresh concrete and for general clean-up work

EXAMPLE:

FIGURE 24

INFORMATION SHEET

I. Exposed aggregate broom — Used to wash off excess materials and clean slab when finishing slabs with exposed aggregate

EXAMPLE:

FIGURE 25

J. Utility brush — Used in finishing and rubbing operations and to clean other tools

EXAMPLE:

FIGURE 26

INFORMATION SHEET

K. Chisel — Used to cut off projections and to chip off loose or scaled concrete

EXAMPLES:

FIGURE 27

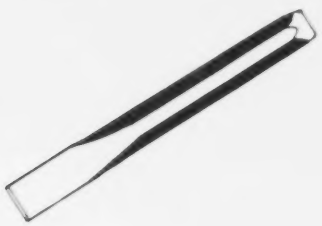


FIGURE 28

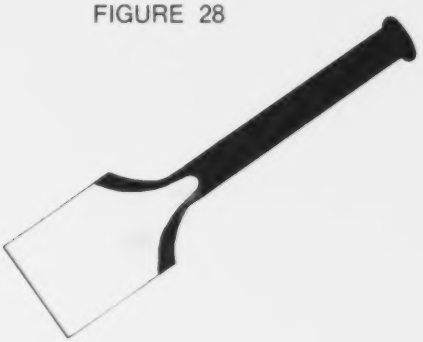
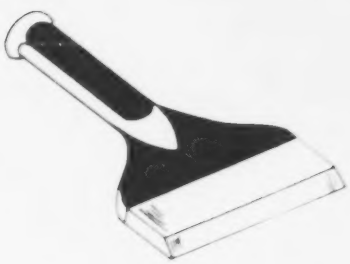


FIGURE 29



L. Flat file — Used to dress edges of trowels and to file off burrs on other tools

EXAMPLE:

FIGURE 30

IX. Terms and definitions associated with concrete finishing tools

A. **Placing** — Process of distributing concrete

B. **Finishing** — Process of working concrete to desired texture

INFORMATION SHEET

C. **Void** — Empty space, gap

D. **Honeycomb** — Void or cavity left in concrete due to ineffective consolidation

E. **Rod** — To level concrete to a specific grade

F. **Float** — To finish fresh concrete surface by use of a float; precedes troweling when that is to be final finish

G. **Low-slump concrete** — Concrete with a stiff consistency

H. **Patching** — Process of filling form-tie holes, honeycombs, or any other defects in concrete

I. **Cove** — Concave or radius at bottom section of curb, step, or base

J. **Base** — Bottom section of a wall

X. Specific uses of hand tools used for placing and finishing fresh concrete

A. Shovels — Used to place and puddle concrete alongside edge forms to prevent voids and honeycombing (Figure 31)

EXAMPLE:

FIGURE 31

B. Straightedges — Used to rod concrete surface to a given grade

C. Darbies — Used to darby concrete surface to eliminate any high or low spots or ridges left after rodding process

D. Bullfloats — Used on large concrete surfaces to eliminate any high or low spots or ridges left after rodding process

E. Tampers (tamps) — Used on low-slump (1 inch or less) concrete to embed coarse aggregate just below concrete surface and to consolidate concrete surface

F. Edgers — Used to form a radius at concrete slab edges to improve appearance and reduce risk of damage to edges

INFORMATION SHEET

G. Jointers (groovers) — Used to cut joints (grooves) partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance

(NOTE: Control joints do not extend completely through the slab but are cut to a depth one-fourth the thickness of the slab.)

H. Hand floats — Used to float concrete around hard-to-reach places and to prepare concrete surface for troweling

I. Trowels — Used to give concrete surface a dense, smooth finish

J. Combination tools — Used to do at least two jobs at the same time

EXAMPLE: Edger/jointer

XI. Hand tools used for finishing fresh concrete

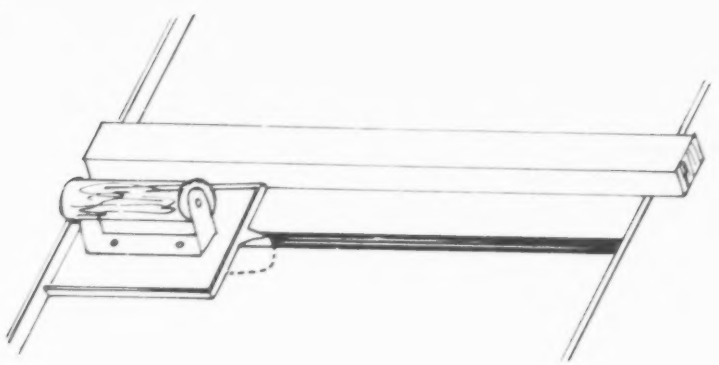
A. Types of straightedges (Figures 32-35)

1. Common wood or magnesium straightedge

(NOTE: The common wood or magnesium straightedge is used to rod concrete after it has been placed. The common wood straightedge is generally made of 1 1/4 inch stock. The common magnesium straightedge is usually 1 inch thick and 4 1/2 wide. Straightedges come in lengths ranging from 3 to 16 feet, the length used depending on the distance between the edge forms. Both wood and magnesium straightedges can be used on the same types of jobs, but magnesium straightedges work better on some toppings, prevent drag, and are preferred as a guide when cutting joints.)

FIGURE 32

FIGURE 33

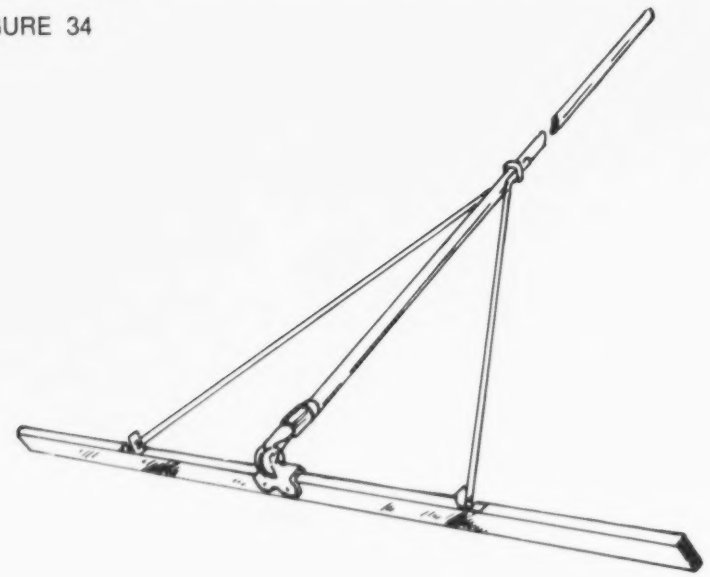


INFORMATION SHEET

2. Paver's (highway) straightedge

(NOTE: The paver's straightedge has a stationary head and a long handle. It is used to check pavement levelness, to cut off high places, and to fill voids.)

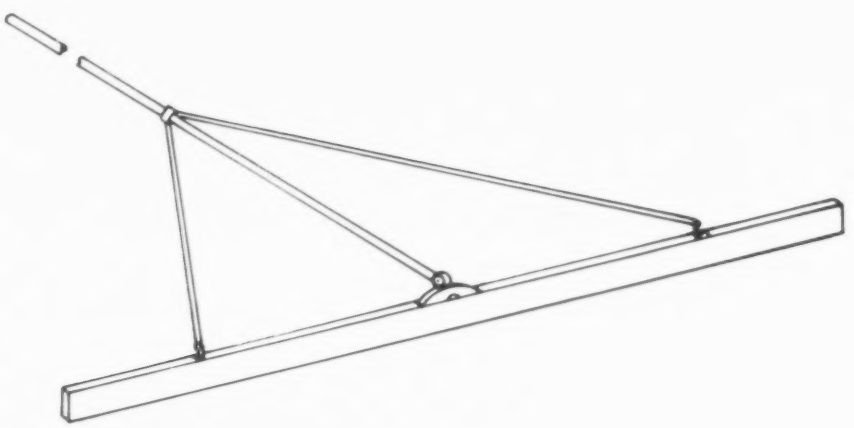
FIGURE 34



3. Long-handled, 12-foot, adjustable-head straightedge

(NOTE: The long-handled, 12-foot, adjustable-head straightedge is a heavy straightedge used at right angles to the rodding process to strike off slabs to create super-flat floors.)

FIGURE 35



INFORMATION SHEET

B. Types of darbies (Figures 36-38)

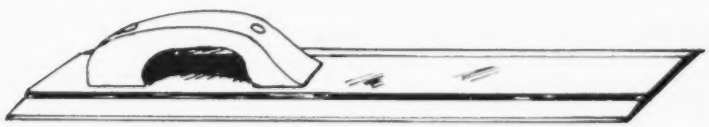
(NOTE: Darbies are long, flat rectangular pieces of wood or magnesium that have handles and come in lengths of from 2 1/2 to 6 1/2 feet and widths from 3 to 4 inches. Magnesium and wood darbies can be used on the same types of jobs [roof slabs, pavement, and sidewalks], but magnesium darbies are more durable, prevent drag, and are preferred on some types of topping and on air-entrained concrete.)

1. Wood darby

FIGURE 36

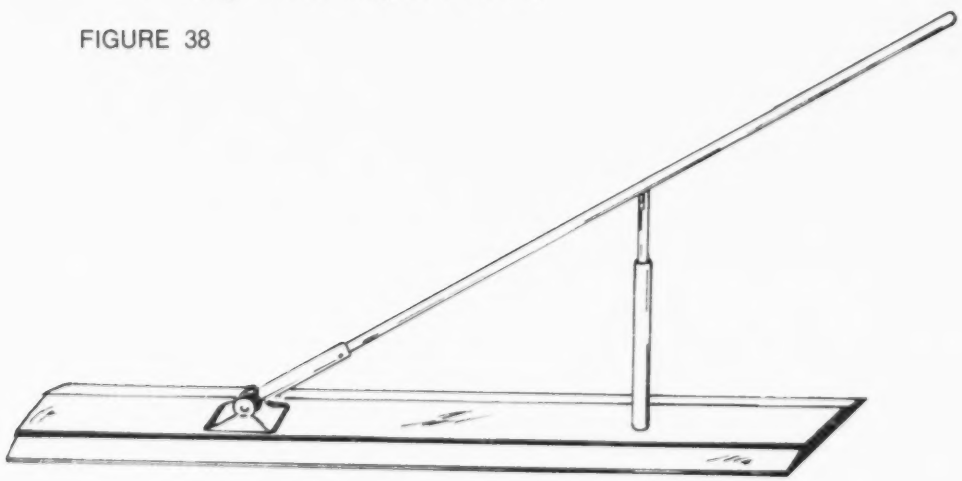
2. Small magnesium darby

FIGURE 37



3. Long-handled magnesium darby

FIGURE 38



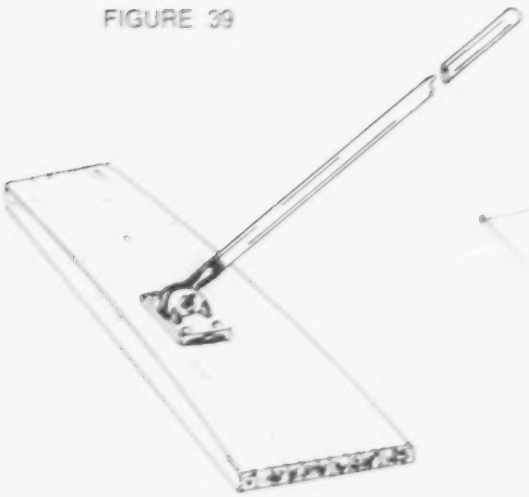
INFORMATION SHEET

C. Types of bullfloats (Figures 39 and 40)

(NOTE: Bullfloats serve the same general function as darbies, but they are more commonly used in locations where there is enough room to accommodate their 4- to 18-foot handle. The tool itself is a large, flat, rectangular piece of wood or metal [aluminum or magnesium] that is usually 8 inches wide and ranges in length from 3 ½ to 5 feet. Both wood and metal bullfloats can be used to bullfloat floor slabs, pavement, and sidewalks made with normal types of concrete, but metal bullfloats prevent drag, are much lighter than wood bullfloats, and are preferred on some toppings, low-slump concrete, and air-entrained concrete.)

1. Wood bullfloat

FIGURE 39



2. Metal (magnesium or aluminum) bullfloat

FIGURE 40

D. Types of tampers (tamps) (Figures 41-43)

(NOTE: There are three basic types of tampers: the small, flat, hand-held type; the larger 3- to 4-foot jitterbug; and the largest 3- to 6-foot rollerbug. The size of the job determines the size of the tamper used, but all types are used only on low-slump [1 inch or less] concrete.)

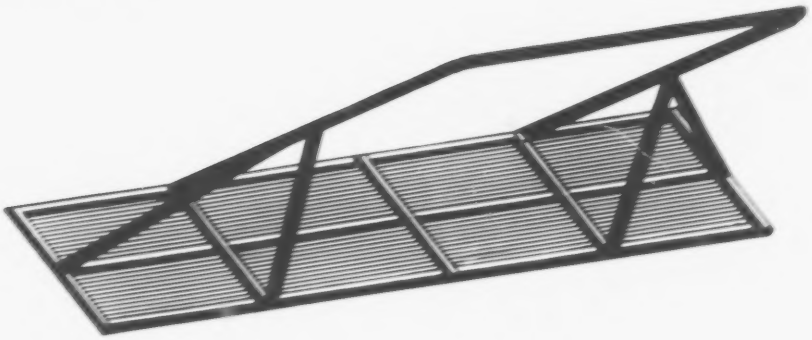
1. Hand tamper

FIGURE 41

INFORMATION SHEET

2. Jitterbug

FIGURE 42



3. Rollerbug

FIGURE 43

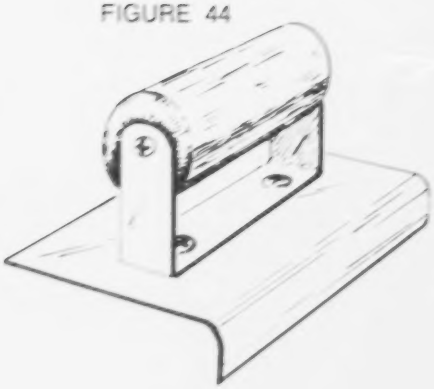
INFORMATION SHEET

E. Types of edgers (Figures 44-49)

(NOTE: Edgers are made of steel, stainless steel, bronze, or malleable iron. They are available in many sizes, but the most common sizes are those from 6 to 10 inches long, from 1 ½ to 4 inches wide, and with a lip that is from ⅛ to ⅝ inch and a radius from ⅛ to 1 ½ inch. Edgers are used to edge sidewalks, floor slabs, driveway approaches, and pavement. Some edgers have a long handle so that they can be used while the mason is standing.)

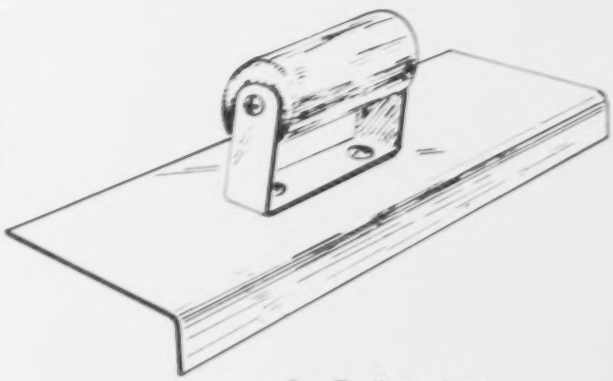
1. Sidewalk edger

FIGURE 44



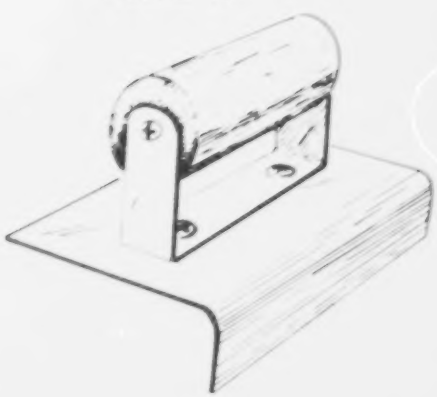
2. Pavement edger

FIGURE 45



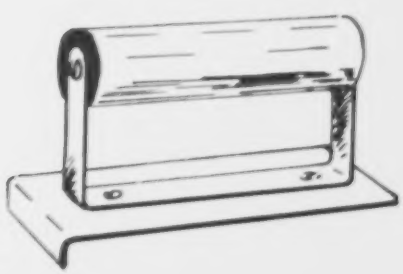
3. Curb edger

FIGURE 46



3. Radius edger

FIGURE 47



INFORMATION SHEET

5. Step-and-windowsill edger

FIGURE 48

6. Long-handled walking-type edger

FIGURE 49

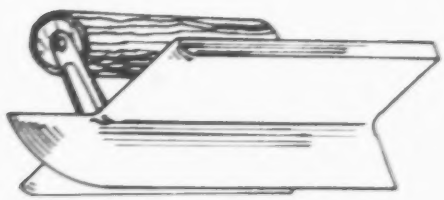
F. Types of jointers (groovers) (Figures 50-52)

(NOTE: Jointers are made of stainless steel, bronze, or malleable iron. Common jointers are 6 inches long; vary in width from 2 to 4 1/2 inches; and have shallow, medium, or deep bits [cutting edges] ranging from 3/16 to 1 inch in depth. Some jointers also have a long handle so that they can be used while the mason is standing. Jointers are used to make joints in sidewalks, pavement, patios, and floor slabs.)

INFORMATION SHEET

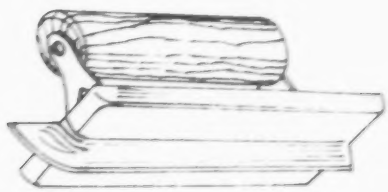
1. Deep-bit hand-type jointer

FIGURE 50



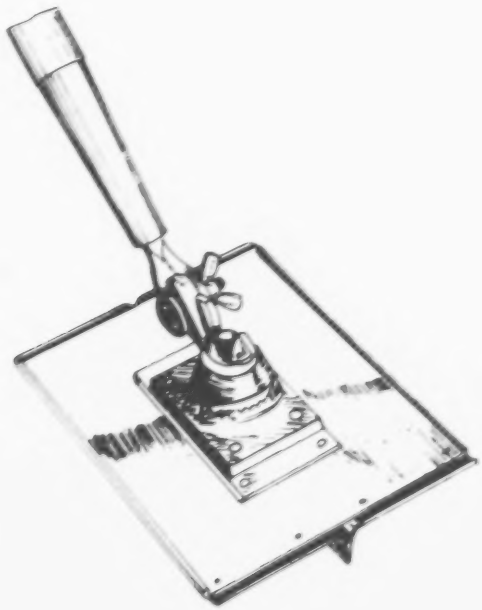
2. Small-bit hand-type jointer

FIGURE 51



3. Long-handled walking-type jointer

FIGURE 52



G. Types of hand floats (Figures 53-57)

(NOTE: Common hand floats are made of wood or metal [steel, aluminum, or magnesium]. Metal floats are usually 3 1/2 inches wide, but come in one of two lengths: 12 or 16 inches. Wood floats are available in 12-, 15-, or 18-inch lengths and in 3 1/2- or 4 1/2-inch widths. Both metal and wood hand floats can be used to float normal types of concrete; however, metal floats prevent drag, are lighter than wood floats, and are preferred on some types of toppings and on air-entrained concrete. Special types of hand floats made of cork, rubber/sponge, or carpet are used to create textured finishes on rubbed concrete.)

INFORMATION SHEET

1. Common wood or metal float

FIGURE 53: Wood float

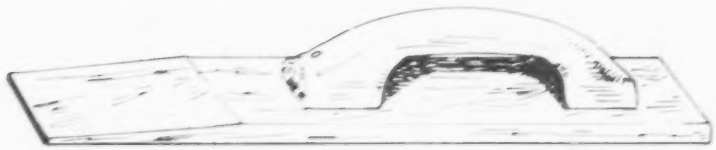


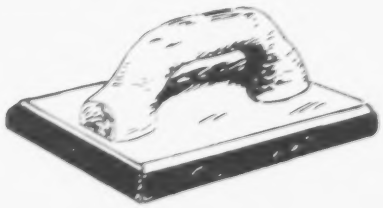
FIGURE 54: Magnesium float

2. Special cork float

FIGURE 55

3. Special rubber/ sponge float

FIGURE 56



4. Special carpet float

FIGURE 57

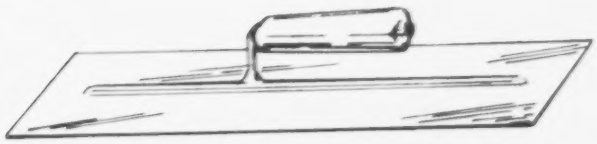
INFORMATION SHEET

H. Types of trowels (Figures 58-61)

(NOTE: Hand trowels are made from either high-carbon tempered steel or special long-wearing stainless steel, and they come in a variety of sizes ranging from 10 to 20 inches long and from 3 to 5 inches wide. The size chosen depends on the job to be done. For example, a wide trowel [16 to 20 inches] is usually used for the first troweling process, while a smaller trowel [14 to 16 inches] is used for the final troweling. Also, fresno trowels fitted with long handles are used when the mason must stand to trowel the concrete surface.)

1. Finishing trowel

FIGURE 58



2. Midget trowel

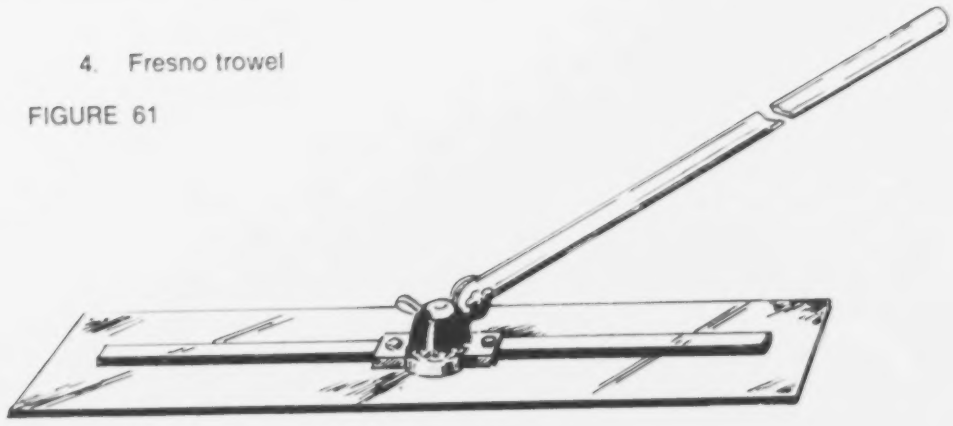
FIGURE 59

3. Pipe trowel

FIGURE 60

4. Fresno trowel

FIGURE 61



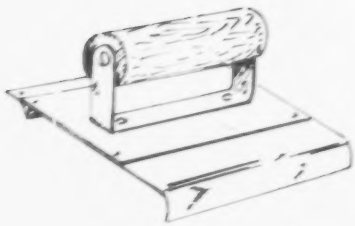
INFORMATION SHEET

I. Types of combination tools (Figures 62-67)

(NOTE: Combination tools are tools designed to do the special jobs their names suggest: edge and joint, curb and gutter, etc. In the past, these tools were made of metal, but some are now being made from new plastics that have been developed.)

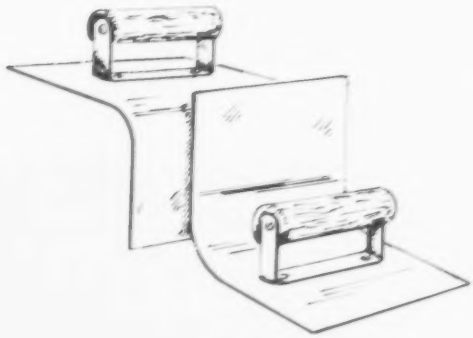
1. Edger/jointer

FIGURE 62



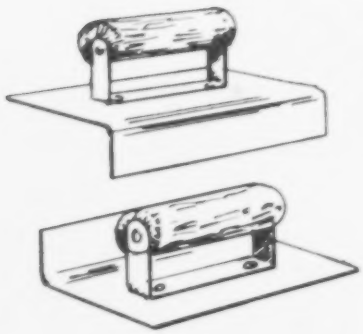
2. Curb-and-gutter tool

FIGURE 63



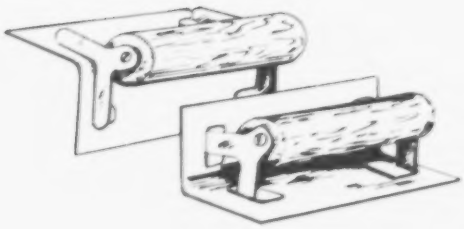
3. Step-and-sidewalk tool

FIGURE 64



4. Step-and-corner tool

FIGURE 65



INFORMATION SHEET

5. Cove-and-base tools

FIGURE 66

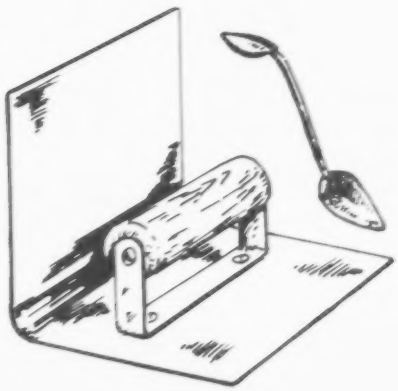
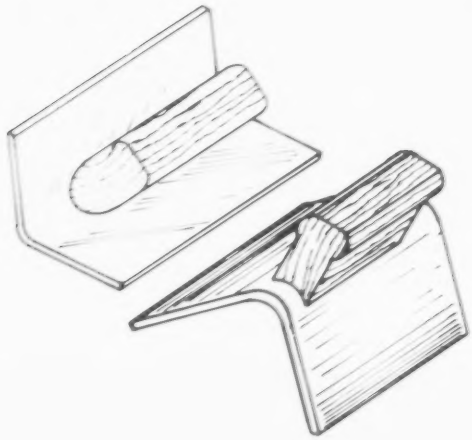


FIGURE 67

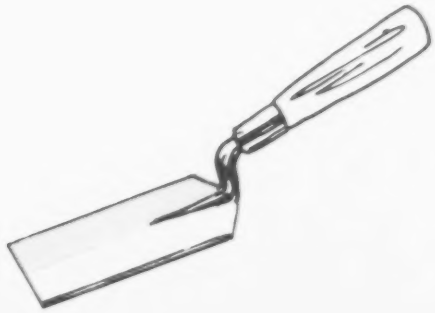


XII. Hand tools used for patching and mixing concrete (Figure 68 and 69)

A. Margin trowel

(NOTE: The margin trowel is used primarily to mix mud, patch holes, and grout machine bases; however, it can also be used to finish patches and small, difficult-to-reach areas.)

FIGURE 68



INFORMATION SHEET

B. Pointing trowel

(NOTE: The pointing trowel is the tool most commonly used by masons. It is used to patch holes, to grout machine bases, and to clean other tools such as bullfloats, trowel-machine blades, and knee boards.)

FIGURE 69

XIII. Hand tools used for working with hardened concrete

A. Types of concrete hammers (Figures 70-72)

(NOTE: There are two types of hammer used by masons to work with hardened concrete: the chipping hammer and the bush hammer. Chipping hammers are used to cut off projections and high places on hardened concrete and to fracture aggregate to present a rough, colorful finish.)

1. Chipping hammers

FIGURE 70

FIGURE 71

INFORMATION SHEET

2. Bush hammer

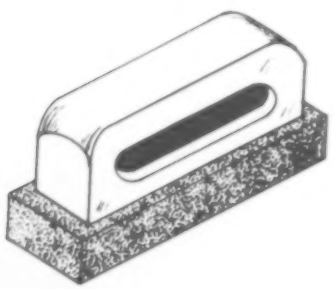
FIGURE 72

B. Types of Carborundum rubbing stones (Figures 73-75)

(NOTE: Rubbing stones are tools used for dressing down hardened concrete. Common rubbing stones are 6 to 8 inches long, 2 to 3 1/2 inches wide, and 3/4 to 2 inches thick. Grit sizes range from #24 [coarse] to #150 [fine].)

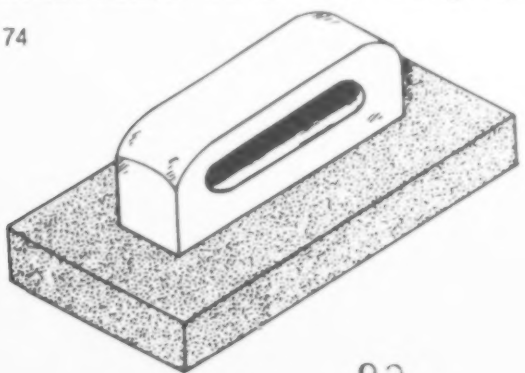
1. Small, 6" x 2" x 1" rubbing stone

FIGURE 73



2. Medium-sized, 8" x 3 1/2" x 3/4" rubbing stone

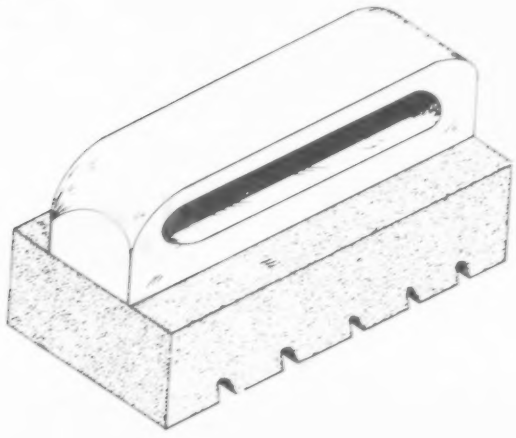
FIGURE 74



INFORMATION SHEET

3. Large-sized, fluted, 8" x 3 1/2" x 1" rubbing stone

FIGURE 75



XiV. Terms and definitions associated with concrete power tools

A. **Occupational Safety and Health Act (OSHA)** — Federal legislation designed to ensure safe and sanitary work conditions for employees

B. **Curing compound** — Liquid coating applied to newly placed concrete to maintain satisfactory moisture content and temperature in concrete during early stages so that desired concrete properties may develop

C. **Control joint** — Joint cut in concrete to regulate the location of cracking

D. **Decorative joint** — Joint cut in concrete for decorative purposes

E. **Monomolecular film** — Compound sprayed on fresh concrete to reduce rapid evaporation of moisture from concrete to maintain satisfactory moisture content during curing so that desired concrete properties may develop

F. **Dry shake** — Dry mixture of cement and fine aggregate that is worked evenly into surface of concrete flatwork before final setting takes place

G. **Terrazzo** — Marble or granite concrete mixture cast in place and ground smooth to create a decorative surface

H. **Fin** — Projection on formed concrete surface, resulting from mortar flowing into spaces in formwork

INFORMATION SHEET

XV. Safety rules pertaining to power tools

(NOTE: Power tools may be operated by electricity [AC or DC], air, combustion engines, or explosive powder.)

A. *Do not* attempt to operate any power tool without being certified by your instructor on that particular tool

B. Always wear appropriate safety equipment and protective clothing for job being done

EXAMPLES: Wear safety glasses and tight-fitting clothing that cannot become caught in the moving parts of the tool. Roll up long sleeves, tuck in shirttail, and tie back long hair.

C. *Do not* leave power tool running unattended

D. Assume a safe and comfortable position before starting a power tool

E. *Do not* distract others or let anyone distract you while operating a power tool

F. Be sure that electric power tool is properly grounded before using

G. Be sure that power is *not* running before performing maintenance or changing accessories

H. *Do not* use dull or broken accessories

I. Use power tool only for its intended use

J. *Do not* use a power tool with guards or safety devices removed

K. Use proper extension cord of sufficient size to service particular electric tool you are using

L. *Do not* operate electric power tool if your hands or feet are wet

M. Before attempting to use it, be familiar with the correct operation and adjustment of power tool

N. Keep a firm grip on power-float or trowel-machine handle while operating machine

O. Be sure there is proper ventilation before operating gasoline-powered equipment indoors

INFORMATION SHEET

P. Keep fire extinguishers handy when filling and operating gasoline-powered equipment

(NOTE: OSHA requires that gasoline-powered equipment be turned off prior to filling with gasoline.)

Q. Lift heavy object with your legs—*not* with your back

R. Keep feet away from cutting tools such as concrete saws, grinders, and trowel-machine blades

XVI. Guidelines for proper care of power tools

A. Keep tools clean and in good working order

B. Follow manufacturer's maintenance procedures

C. Protect cutting edges

D. Keep tool accessories properly maintained

E. Report any unusual noises, sounds, or vibrations to the instructor or supervisor

F. Inspect tools and accessories regularly

G. Store tools properly when not in use

H. Clean spraying equipment immediately after each job

I. Change trowel-machine blades when they become ragged

XVII. General uses of power tools used for placing and finishing fresh concrete

A. Power straightedges — Used on various types of jobs to compact concrete, to bring concrete to desired grade and to prepare concrete for finishing procedures

B. Power tampers — Used to consolidate low slump (1 inch or less) concrete, to bring fines to the surface and to level the surface of the concrete

C. Power float machines — Used on flat concrete to consolidate concrete, to remove slight imperfections, to bring fines to the surface, to open concrete surface so that bleed water can escape, to work dry-shake materials into surface, and sometimes to finish the surface of the concrete

D. Power finishing machines — Used to finish all types and sizes of concrete slabs

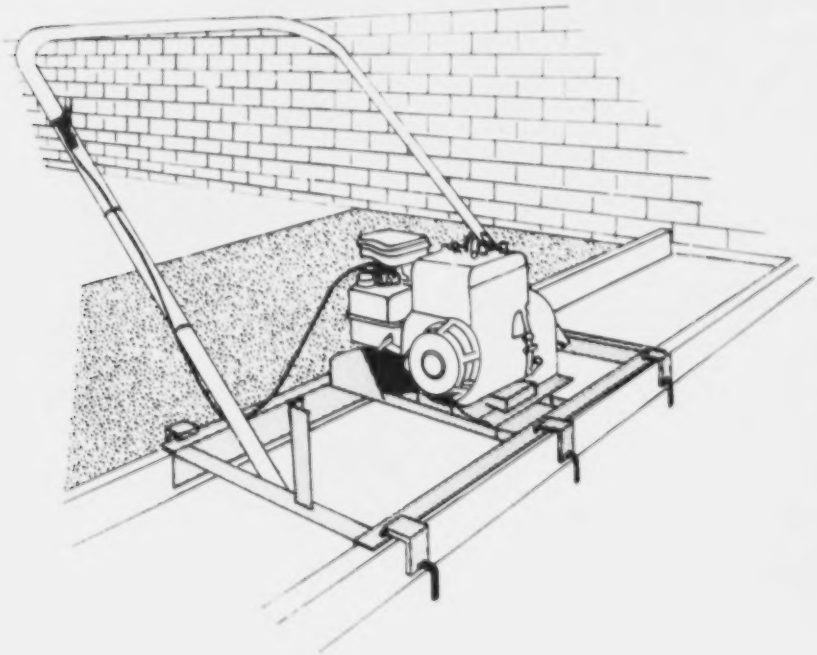
XVIII. Types of power tools used for placing and finishing fresh concrete

A. Types of power straightedges (Figures 76-79)

INFORMATION SHEET

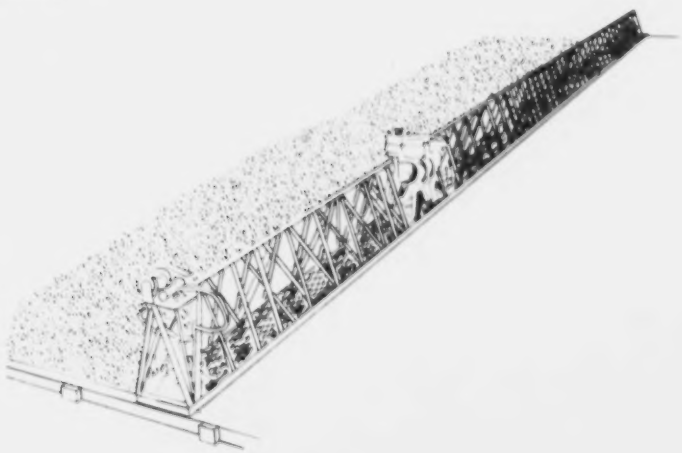
1. Small portable power straightedge

FIGURE 76



2. Heavy-duty vibrating-type power straightedge

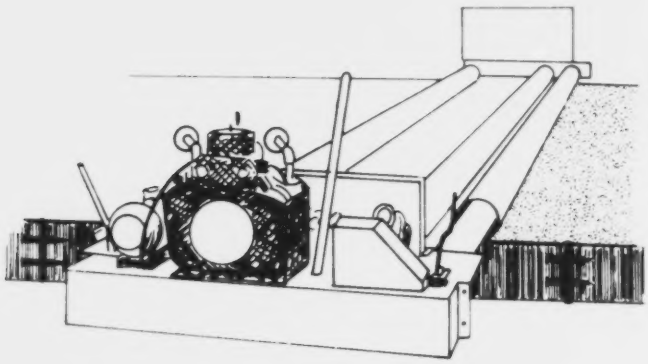
FIGURE 77



INFORMATION SHEET

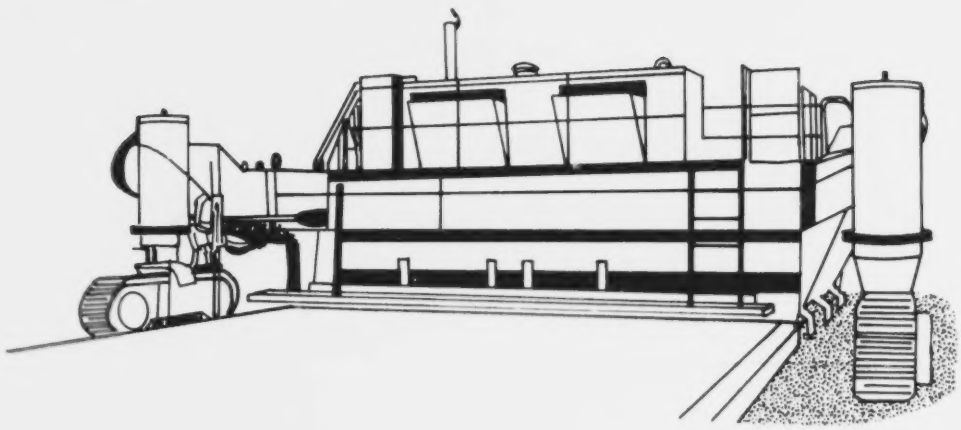
3. Roller-type (tube-type) power straightedge

FIGURE 78



4. Slip-form paver

FIGURE 79

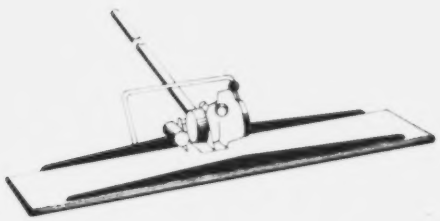


INFORMATION SHEET

B. Types of power tampers (Figures 80 and 81)

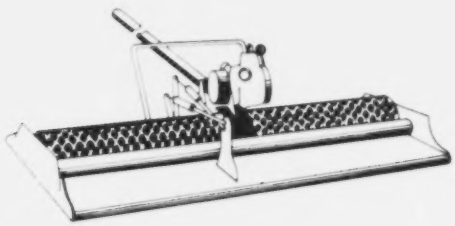
1. Vibrating bullfloat/tamper

FIGURE 80



2. Vibrating tamper (vibra tamp)

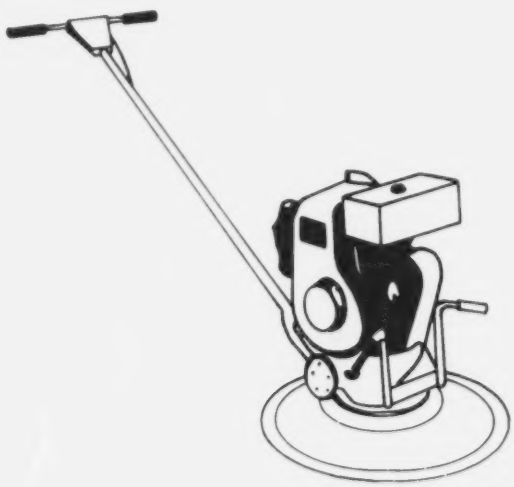
FIGURE 81



C. Types of power floats (Figures 82 and 83)

1. Kelly float

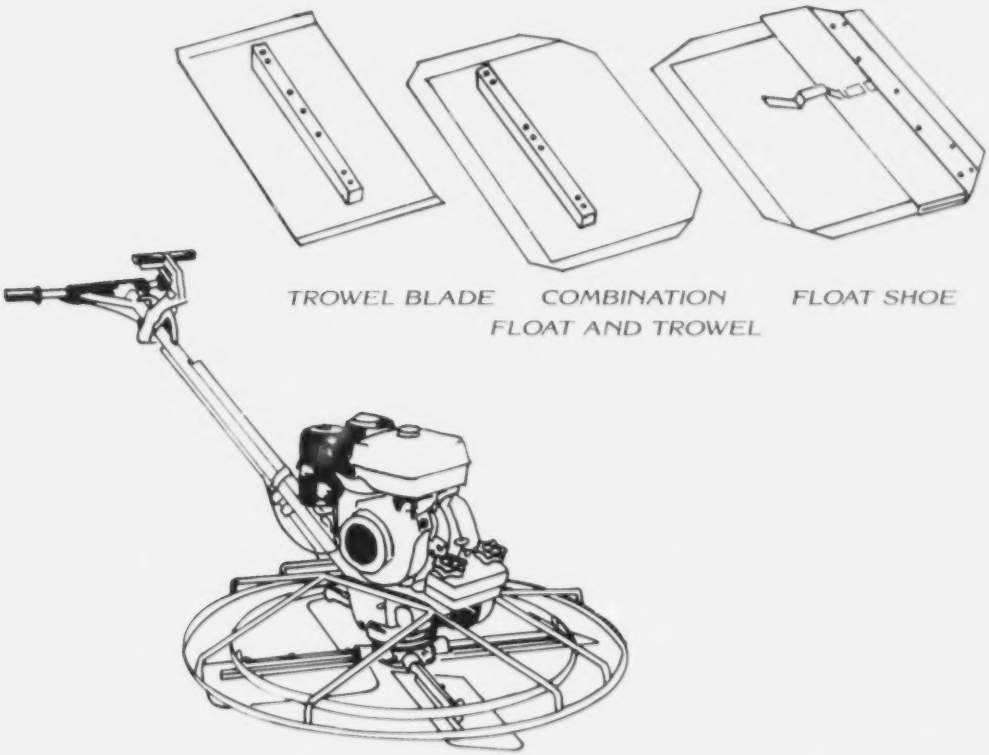
FIGURE 82



INFORMATION SHEET

2. Trowel machine with blade attachments

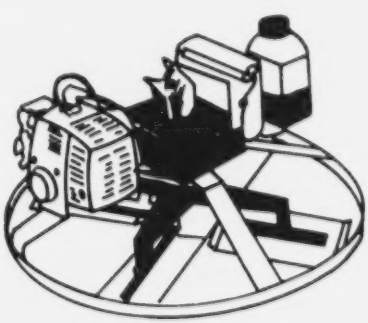
FIGURE 83



D. Types of power finishing machines (Figures 84-88)

1. Hand-held power trowel

FIGURE 84



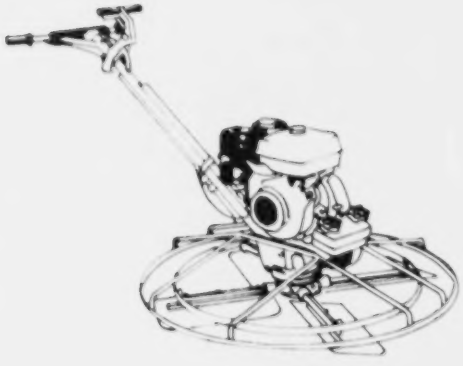
INFORMATION SHEET

2. Pony trowel

FIGURE 85

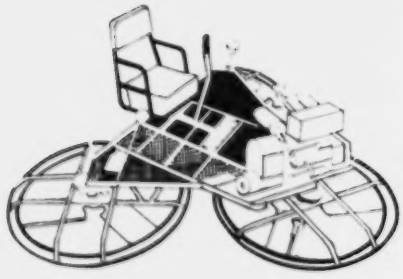
3. Trowel machine

FIGURE 86



4. Riding trowel machine

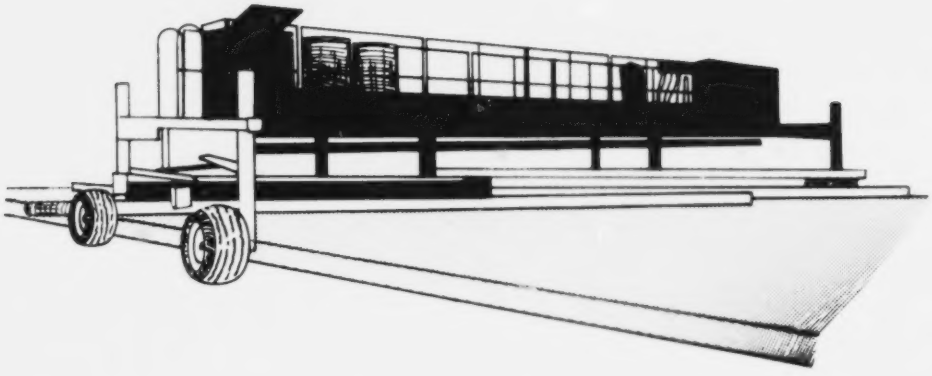
FIGURE 87



INFORMATION SHEET

5. Concrete finisher

FIGURE 88



XIX. General uses of sprayers

A. To spray form oil on concrete forms

B. To spray curing compounds on finished concrete

C. To spray monomolecular film on fresh concrete to reduce rapid evaporation

D. To mist or fog finish concrete with water until suitable curing can take place

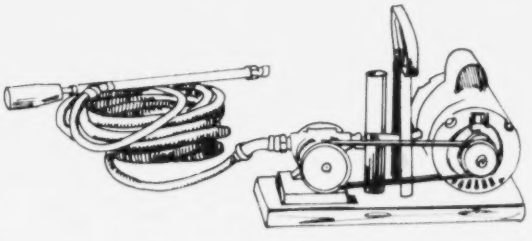
XX. Types of sprayers (Figures 89-91)

A. Hand-held tank sprayer

FIGURE 89

B. Electric-powered sprayer

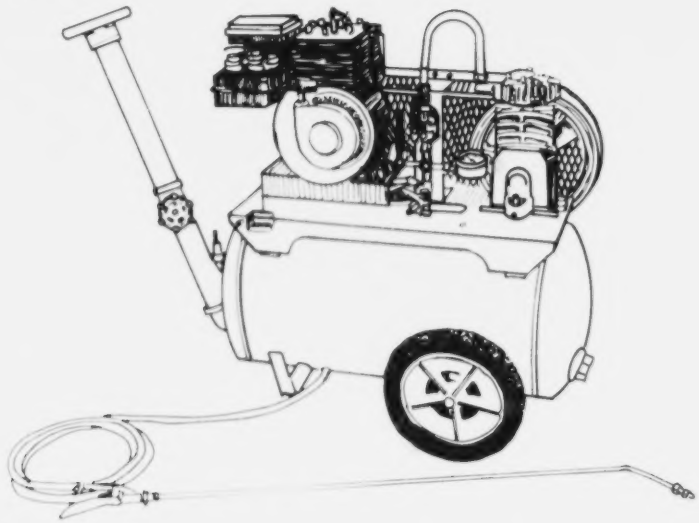
FIGURE 90



INFORMATION SHEET

C. Gasoline-powered sprayer

FIGURE 91



XXI. General uses of power saws

A. To cut control joints in concrete

B. To cut decorative joints in concrete

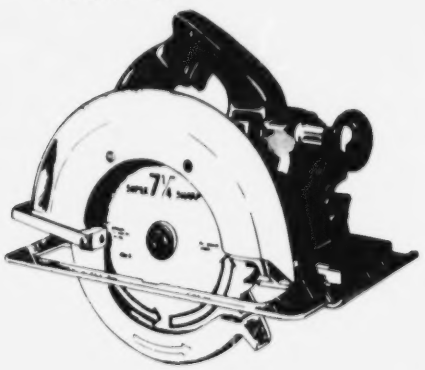
C. To cut out sections of concrete for replacement

D. To make cuts when demolishing concrete structures or slabs

XXII. Types of power saws (Figures 92-95)

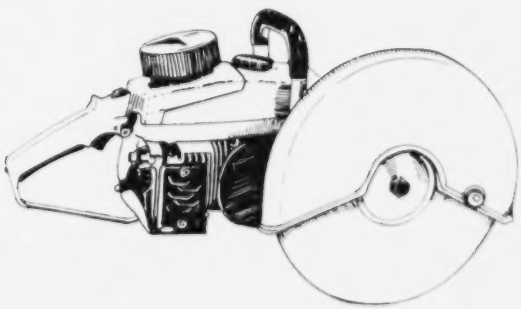
A. Portable electric-powered saw

FIGURE 92



B. Portable gasoline-powered saw

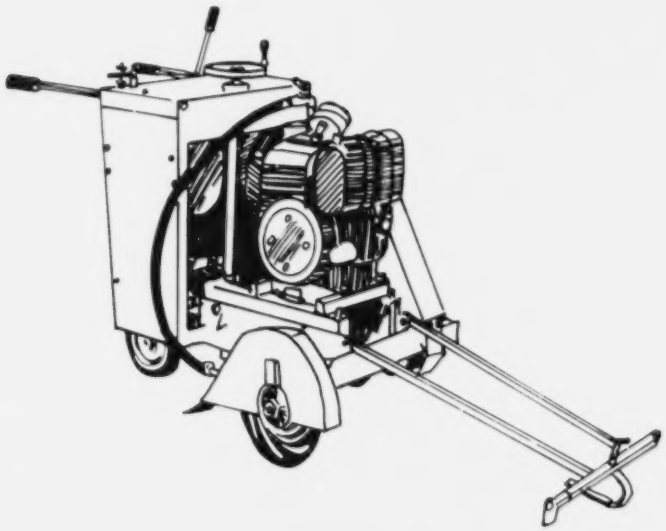
FIGURE 93



INFORMATION SHEET

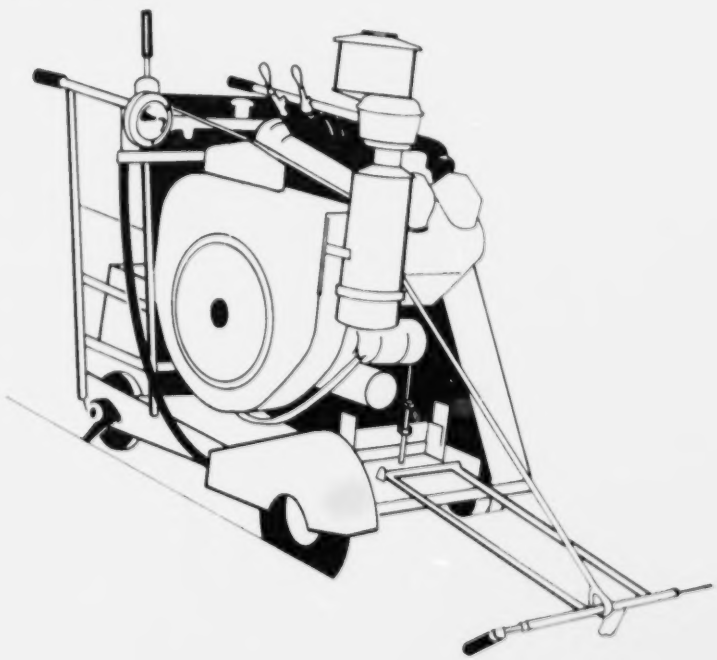
C. Medium-duty floor-type power saw

FIGURE 94



D. Heavy-duty floor-type power saw

FIGURE 95



INFORMATION SHEET

XXIII. Specific uses for types of power grinders

A. Hand-held electric-powered grinder — Used to remove seams and projections on walls

B. Portable, flexible-hose, direct-drive, electric-powered grinder — Used to rub and to finish walls

C. Portable, vibrator-type, gasoline-powered grinder — Used to rub and to finish walls

D. Trowel machine with grinder head — Used to grind high spots from floors and pavement and to grind floors prior to refinishing

E. Commercial-type floor grinder — Used to grind high spots from floors and pavement and to grind floors prior to refinishing

F. Edge-and-base grinder — Used to grind floors along obstructions and to finish concrete and terrazzo base

G. Ceiling grinder — Used to remove projections on concrete-ceiling surface and to prepare ceiling for final finish

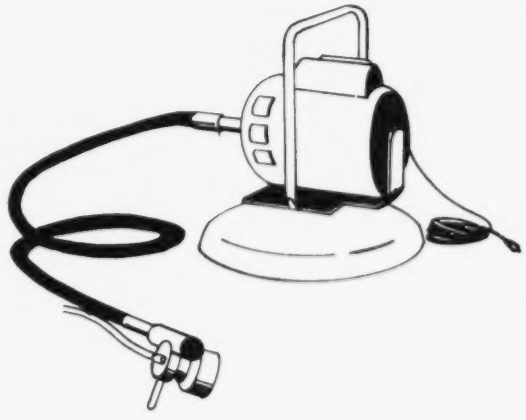
XXIV. Types of power grinders (Figures 96-102)

A. Hand-held electric-powered grinder

FIGURE 96

B. Portable, flexible-hose, direct-drive, electric-powered grinder

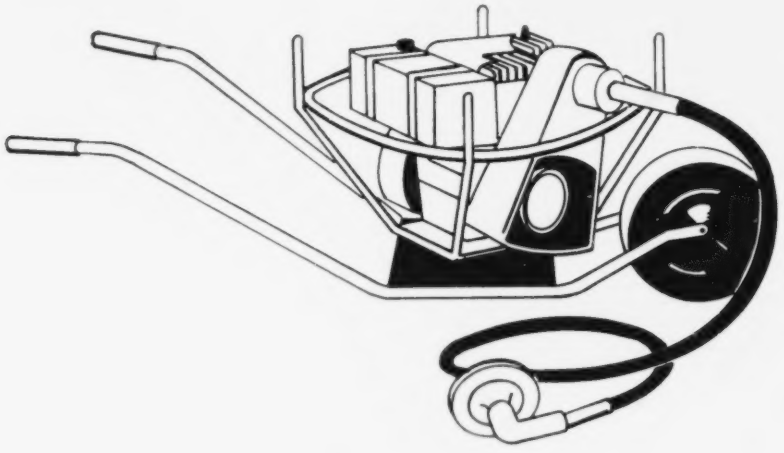
FIGURE 97



INFORMATION SHEET

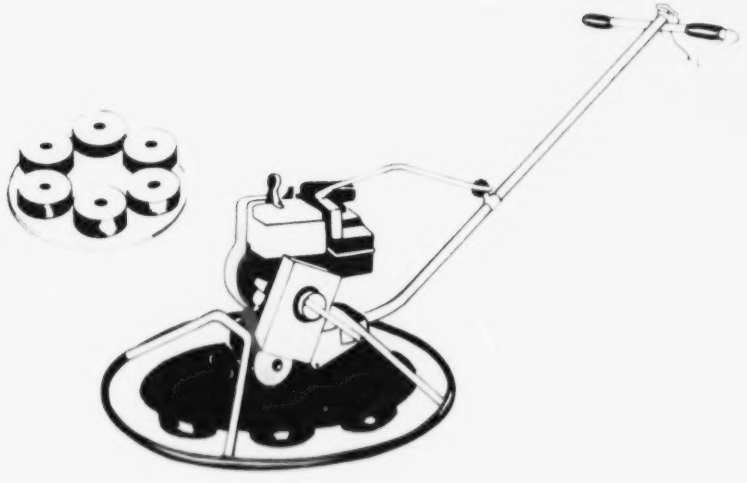
C. Portable, vibrator-type, gasoline-powered grinder

FIGURE 98



D. Trowel machine with grinder head

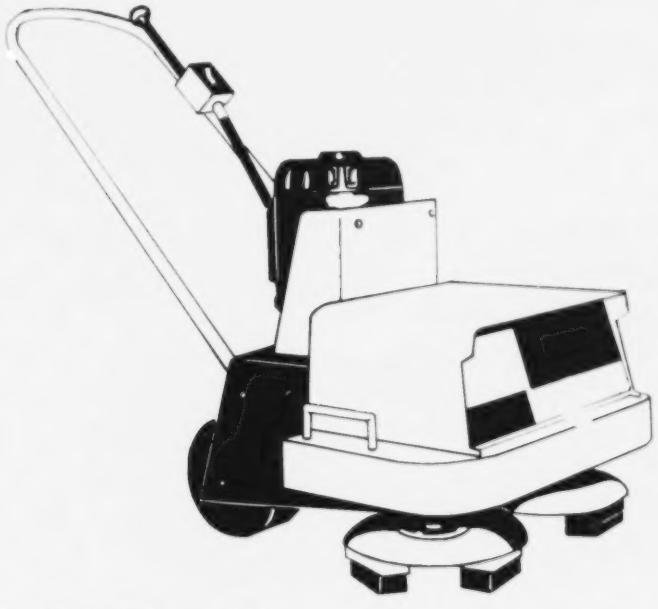
FIGURE 99



INFORMATION SHEET

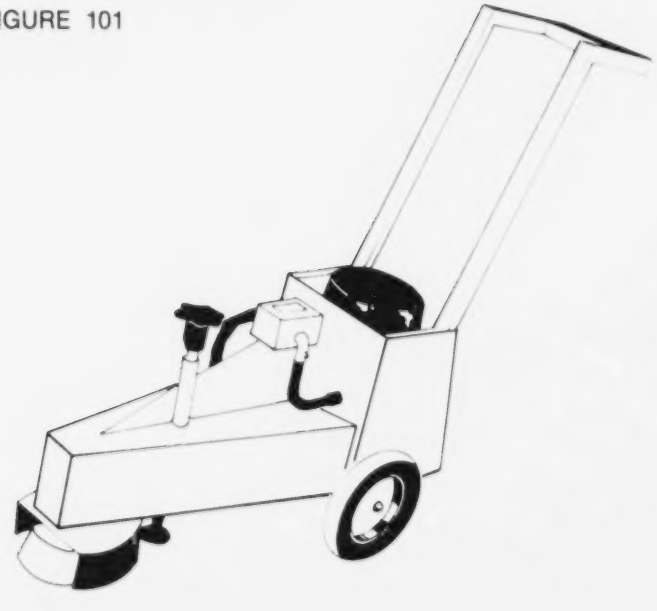
E. Commercial-type floor grinder

FIGURE 100



F. Edge-and-base grinder

FIGURE 101



INFORMATION SHEET

G. Ceiling grinder

FIGURE 102

CONCRETE TOOLS
UNIT II

ASSIGNMENT SHEET #1 — COMPLETE A SAFETY TEST PERTAINING TO POWER TOOLS

NAME _____ SCORE _____

To operate power tools safely, you must know the safety rules pertaining to power tools. Therefore, before you will be allowed to operate any power tool, you will be required to show you know the power-tool safety rules by scoring 100 percent on the safety test that follows.

Fill in the blanks to complete the following rules for safe use of power tools.

A. *Do not* attempt to operate any power tool without being _____ by your instructor on that particular tool.

B. Always wear appropriate _____ _____ and _____ _____ for job being done.

C. *Do not* leave power tool running _____.

D. Assume a _____ and _____ position before starting a power tool.

E. *Do not* _____ others or let anyone _____ you while operating a power tool.

F. Be sure that electric power tool is properly _____ before using.

G. Be sure that power tool is *not* _____ before performing maintenance or changing accessories.

H. *Do not* use _____ or _____ accessories.

ASSIGNMENT SHEET #1

I. Use power tool only for its intended _____.

J. *Do not* use a power tool with _____ or _____ _____ removed.

K. Use proper extension cord of sufficient _____ to _____ particular electric tool you are using.

L. *Do not* operate electrical power tool if your hands or feet are _____.

M. Before attempting to use it, be familiar with the correct _____ and _____ of power tool.

N. Keep a _____ _____ on power-float or trowel-machine handle while operating machine.

O. Be sure there is proper _____ before operating gasoline-powered equipment indoors.

P. Keep fire extinguisher handy when _____ and _____ gasoline-powered equipment.

Q. Lift heavy object with your _____—*not* with your _____.

R. Keep _____ away from cutting tools such as concrete saws, grinders, and trowel-machine blades.

CONCRETE TOOLS
UNIT II

ANSWERS TO ASSIGNMENT SHEET #1

A. Certified
B. Safety equipment; protective clothing
C. Unattended
D. Safe; comfortable
E. Distract; distract
F. Grounded
G. Running
H. Dull; broken
I. Use
J. Guards; safety devices
K. Size; service
L. Wet
M. Operation; adjustments
N. Firm grip
O. Ventilation
P. Filling; operating
Q. Legs; back
R. Feet

CONCRETE TOOLS
UNIT II

TEST
PART I (Objectives 1 through 8)

NAME _____ SCORE _____

1. Match terms and definitions associated with concrete forming tools. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a.	Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface	1. Leveling rod 2. Stake 3. Plumb bob
_____b.	Soft stone used for marking	1. Stake 2. Soapstone 3. Square
_____c.	To saw wood with the grain	1. Rip 2. Crosscut 3. Square
_____d.	Pointed piece of wood or metal driven into ground and used to hold forms in place	1. Stake 2. Grade 3. Soapstone
_____e.	Pole with markings graduated upward from zero; used with leveling instrument to determine elevations	1. Stake 2. Square 3. Leveling rod
_____f.	Method of squaring a line by forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, ensuring that longest side of triangle is exact appropriate multiple of 5	1. Squaring method 2. 3-4-5 method 3. Crosscut method
_____g.	Given grade	1. Plumb bob 2. Elevation 3. Grade

TEST

_____h.	Given elevation to which forms are set	1. Elevation 2. Grade 3. Square
_____i.	To saw wood across the grain	1. Rip 2. Crosscut 3. Square
_____j.	To form a right angle; 90 degrees to a straight line	1. Grade 2. Square 3. Crosscut

2. State six rules for care and safe use of hand tools.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

3. Match types of hammers to their correct uses. Write the correct numbers in the blanks.

_____a.	Used to drive and pull nails	1. Curved-claw hammer
_____b.	Used to drive stakes and break concrete	2. Straight-claw hammer
_____c.	Used to drive nails, pull nails, dismantle, and wreck	3. Sledgehammer

4. Match types of saws to their correct uses. Write the correct numbers in the blanks.

_____a.	Used to cut across the grain of wood	1. Rip hand-saw
_____b.	Used to cut with the grain of wood	2. Hacksaw
_____c.	Used to rip and crosscut form material	3. Crosscut hand-saw
_____d.	Used to cut metal	4. Portable power circular saw

TEST

5. Match types of squares to their correct uses. Write the correct numbers in the blanks.

_____a. Used to check squareness and to lay out 45-degree angles	1. Combination square
_____b. Used to square corners, check squareness, and lay out 90-degree angles	2. Framing square

6. Match types of measuring tools to their correct uses. Write the correct numbers in the blanks.

_____a. Used to measure irregular as well as regular shapes and to make accurate inside and outside measurements	1. Flexible steel tape
_____b. Used to make accurate inside and outside measurements for laying out forms, laying out joints, and checking for square	2. Folding rule (zigzag rule)

7. Match types of leveling instruments to their correct uses. Write the correct numbers in the blanks.

_____a. Used to level forms and to transfer and check grades	1. Line level
_____b. Used to check grades on short forms such as step treads	2. Water level
_____c. Used to check grades of a dry line	3. Spirit level
_____d. Used to set and check elevations	4. Torpedo level

TEST

8. Match miscellaneous hand tools and equipment to their correct uses. Write the correct numbers in the blanks.

_____a. Used as a guide to set stakes and forms straight and accurately

_____b. Used to cut expansion material

_____c. Used to pull nails, to pry, and to remove forms

_____d. Used to dress edges of trowels and to file off burrs on other tools

_____e. Used to drive short masonry nails through expansion material and into masonry wall when setting expansion material

_____f. Used to lay out work on concrete, to lay out cut lines on lumber, and to mark joints in concrete

_____g. Used to store and transport tools

_____h. Used to cut and twist wires on reinforcing steel and on forms

_____i. Used in finishing and rubbing operations and to clean other tools

_____j. Used to finish fresh concrete and for general clean-up work

_____k. Used to wash off excess materials and clean slab when finishing slabs with exposed aggregate

_____l. Used to cut off projections and to chip off loose or scaled concrete

1. Utility knife
2. Chalkbox and line
3. Exposed aggregate broom
4. Line (string line; dry line)
5. Ripping bar (wrecking bar)
6. Magnetic nail driver
7. Side-cut pliers
8. Tool bag
9. Chisel
10. Push broom
11. Flat file
12. Utility brush

CONCRETE TOOLS
UNIT II

TEST
PART II (Objectives 9 through 13)

NAME _____ _____ SCORE _____

9. Match terms and definitions associated with concrete finishing tools. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a.	To finish fresh concrete surface by use of a float; precedes troweling when that is to be final finish	1. Place 2. Rod 3. Float
_____b.	Process of filling form-tie holes, honeycombs, or any other defects in concrete	1. Patching 2. Finishing 3. Placing
_____c.	Concave or radius at bottom section of curb, step, or base	1. Rod 2. Void 3. Cove
_____d.	Process of working concrete to desired texture	1. Placing 2. Finishing 3. Patching
_____e.	Process of distributing concrete	1. Placing 2. Finishing 3. Honeycombing
_____f.	Concrete with a stiff consistency	1. High-slump concrete 2. Low-slump concrete 3. Slow concrete
_____g.	Bottom section of a wall	1. Base 2. Rod 3. Cove
_____h.	To level concrete to a specific grade	1. Rod 2. Place 3. Finish

TEST

_____i. Empty space, gap

1. Rod
2. Float
3. Void

_____j. Void or cavity left in concrete due to ineffective consolidation

1. Void
2. Rod
3. Honeycomb

10. State specific uses of hand tools used for placing and finishing fresh concrete.

a. Shovels — _____

b. Straightedges — _____

c. Darbies — _____

d. Bullfloats — _____

e. Tampers (tamps) — _____

f. Edgers — _____

g. Jointers (groovers) — _____

h. Hand floats — _____

i. Trowels — _____

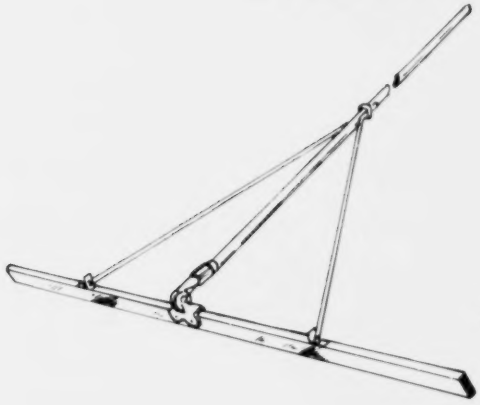
j. Combination tools — _____

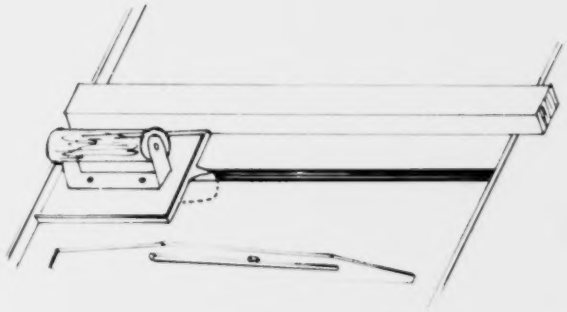
TEST

11. Identify the following hand tools used for placing and finishing fresh concrete. Write the correct names in the blanks.

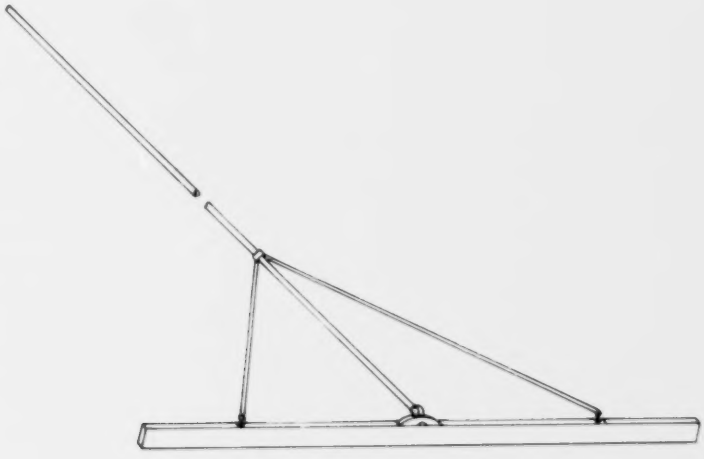
Types of straightedges

Common Wood or magnesium straightedge Paver's (highway) straightedge
Long-handled, 12-foot, adjustable-head straightedge





a. _____ b. _____

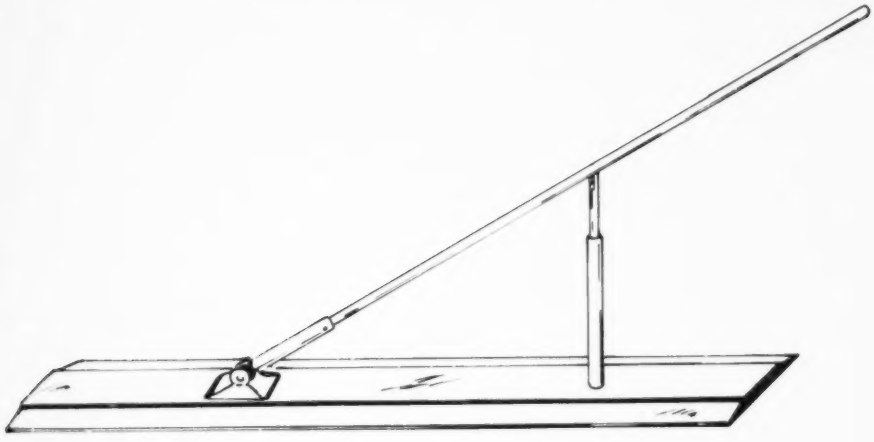


c. _____

TEST

Types of darbies

Wood darby Small magnesium darby Long-handled magnesium darby



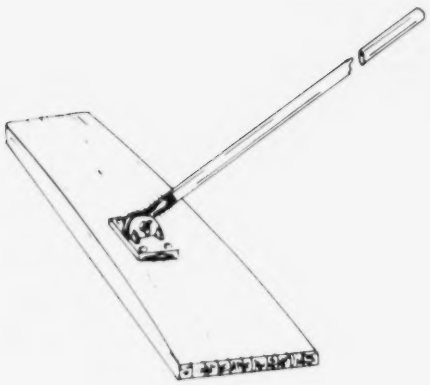
a. _____

b. _____ c. _____

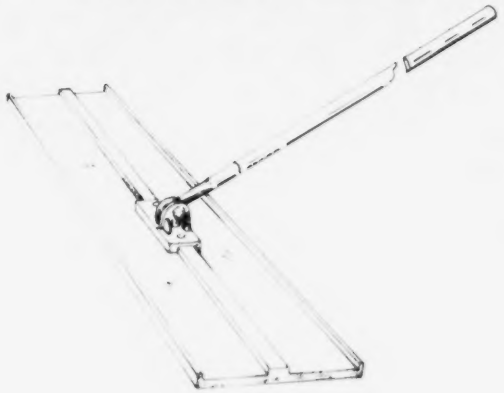
TEST

Types of bullfloats

Wood bullfloat



Metal (magnesium or aluminum) bullfloat

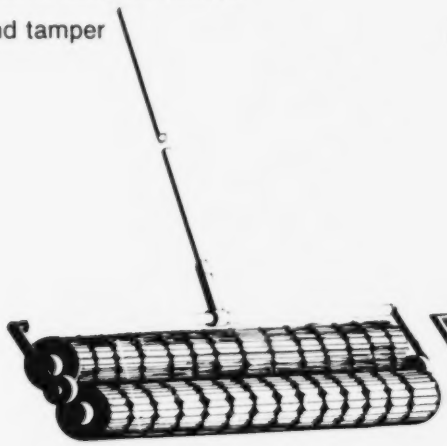


a. _____ b. _____

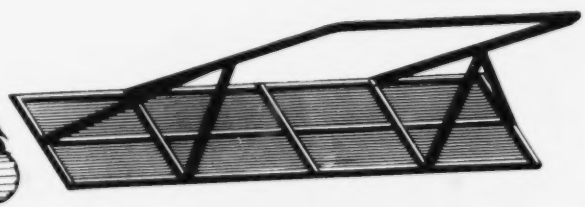
_____ _____

Types of tampers (tamps)

Hand tamper



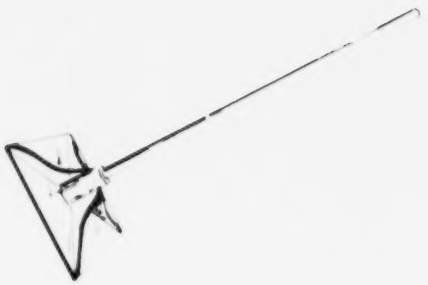
Jitterbug



Rollerbug

a. _____ b. _____

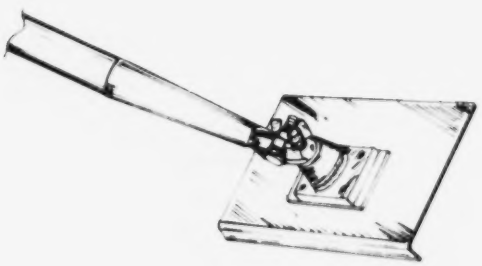
TEST



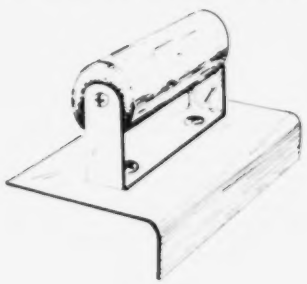
c. _____

Types of edgers

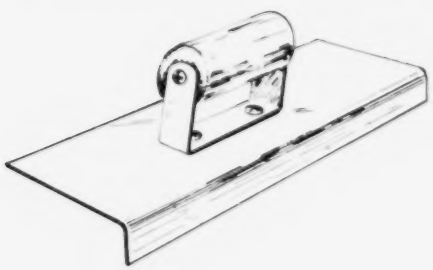
Sidewalk edger
Radius edger
Pavement edger
Step-and-windowsill edger
Curb edger
Long-handled walking-type edger



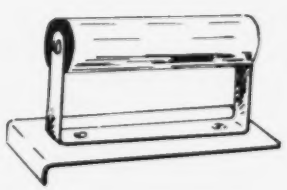
a. _____



b. _____

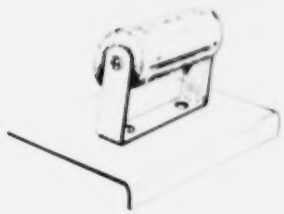


c. _____



d. _____

TEST



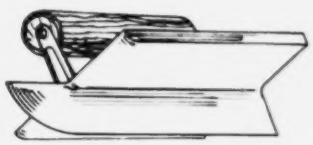
e. _____ f. _____

Types of jointers (groovers)

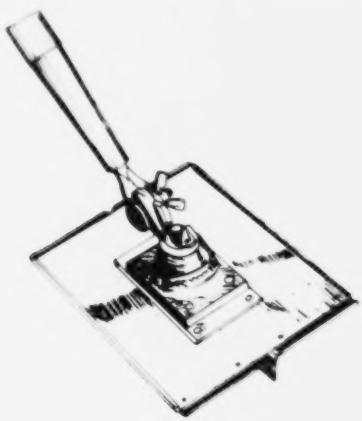
Deep-bit hand-type jointer

Long-handled walking-type jointer

Small-bit hand-type jointer



a. _____ b. _____



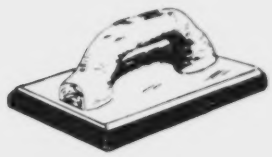
c. _____

TEST

Types of hand floats

Common wood float
Common magnesium float
Special cork float
Special carpet float
Special rubber/sponge float

a. _____ b. _____



c. _____ d. _____

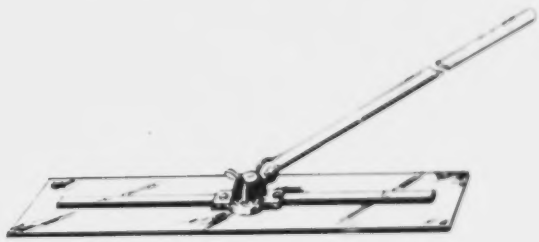
e. _____

TEST

Types of trowels

Finishing trowel Midget trowel Pipe trowel Fresno trowel

a. _____ b. _____



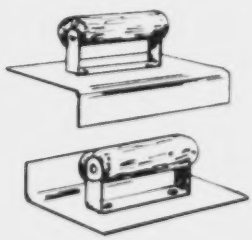
c. _____ d. _____

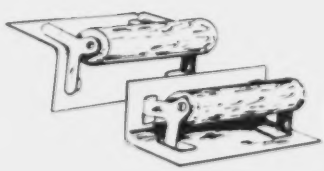
Types of combination tools

Edger/jointer
Cove-and-base tool

Curb-and-gutter tool
Step-and-corner tool

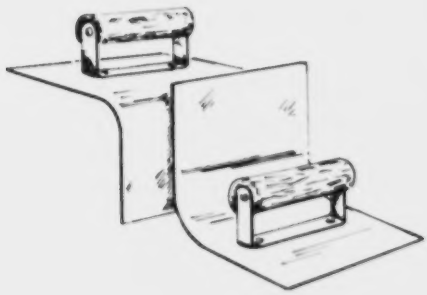
Step-and-sidewalk tool



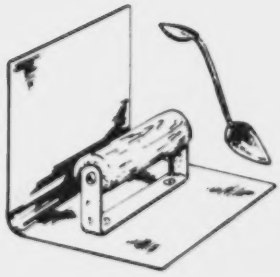


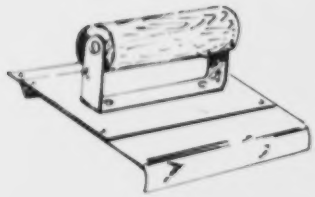
a. _____ b. _____

TEST



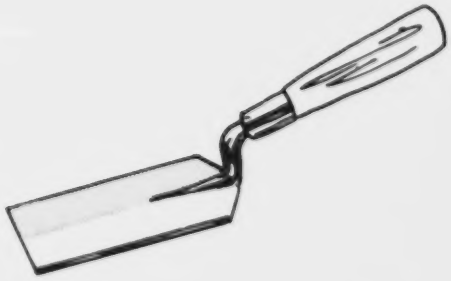
c. _____

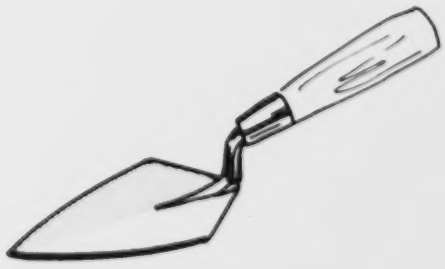




d. _____ e. _____

12. Label the following hand tools used for patching and mixing concrete.

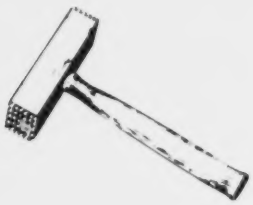


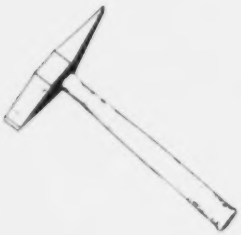


a. _____ b. _____

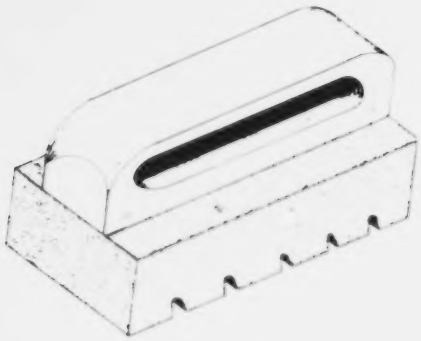
TEST

13. Label the following hand tools used for working with hardened concrete.





a. _____ b. _____



c. _____

CONCRETE TOOLS
UNIT II

TEST
PART III (Objectives 14 through 25)

NAME _____ SCORE _____

14. Match terms and definitions associated with concrete power tools to their correct definitions. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a.	Marble or granite concrete mixture cast in place and ground smooth to create a decorative surface	1. Dry shake 2. Terrazzo 3. Fin
_____b.	Dry mixture of cement and fine aggregate that is worked evenly into surface of concrete flatwork before final setting takes place	1. Dry shake 2. Terrazzo 3. Fin
_____c.	Joint cut in concrete to regulate the location of cracking	1. Finish joint 2. Control joint 3. Decorative joint
_____d.	Joint cut in concrete for decorative purposes	1. Finish joint 2. Control joint 3. Decorative joint
_____e.	Projection on formed concrete surface, resulting from mortar flowing into spaces in formwork	1. Control joint 2. Fin 3. Dry shake
_____f.	Liquid coating applied to newly placed concrete to maintain satisfactory moisture content and temperature in concrete during early stages so that desired concrete properties may develop	1. Monomolecular film 2. Curing compound 3. Terrazzo
_____g.	Compound sprayed on fresh concrete to reduce rapid evaporation of moisture from concrete to maintain satisfactory moisture content during curing so that desired concrete properties may develop	1. Monomolecular film 2. Curing compound 3. Terrazzo
_____h.	Federal legislation designed to ensure safe and sanitary working conditions for employees	1. Occupational Safety and Health Act 2. Job Safety Act 3. Workmen's Compensation

TEST

15. State eight safety rules pertaining to power tools.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

e. _____

_____

f. _____

_____

g. _____

_____

h. _____

_____

16. Select from the following list guidelines for proper care of power tools. Write an "X" in the blank before each correct answer.

_____a. Protect cutting edge

_____b. Clean spraying equipment at least once a week

_____c. Keep tool accessories properly maintained

_____d. Change trowel-machine blades at least twice a year

_____e. Keep tools clean and in good working order

_____f. Inspect tools and accessories upon occasion

_____g. Report any unusual noises, sounds, or vibrations to the custodian

_____h. Keep tools in the classroom when not in use

_____i. Follow manufacturer's maintenance procedures

TEST

17. State general uses of power tools used for placing and finishing fresh concrete.

    a. Power straightedges — _____

    _____

    b. Power tampers — _____

    _____

    c. Power float machines — _____

    _____

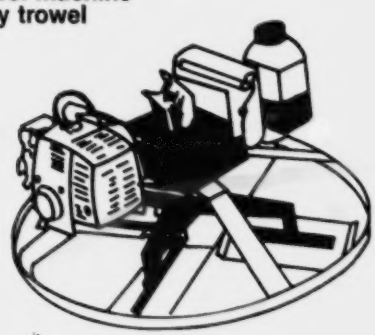
    d. Power finishing machines — _____

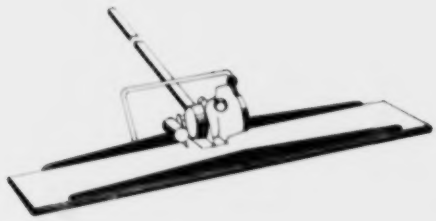
    _____

18. Identify the following types of power tools used for placing and finishing fresh concrete. Write the correct names in the blanks.

Small portable power straightedge
Heavy-duty vibrating-type power straightedge
Trowel machine with blade attachments
Vibrating tamper (vibra tamp)
Riding trowel machine
Trowel machine
Pony trowel

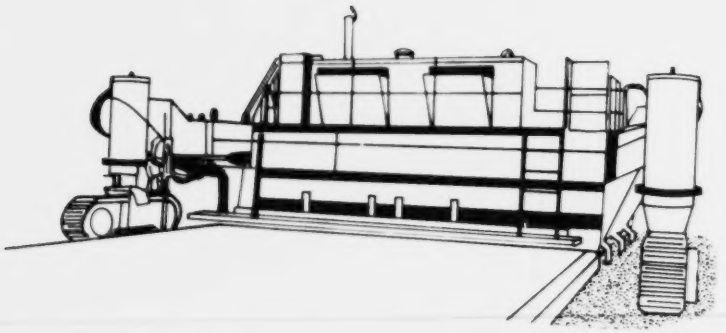
Roller type (tube-type) power straightedge
Vibrating bullfloat/tamper
Hand-held power trowel
Slip-form paver
Kelly float
Concrete finisher



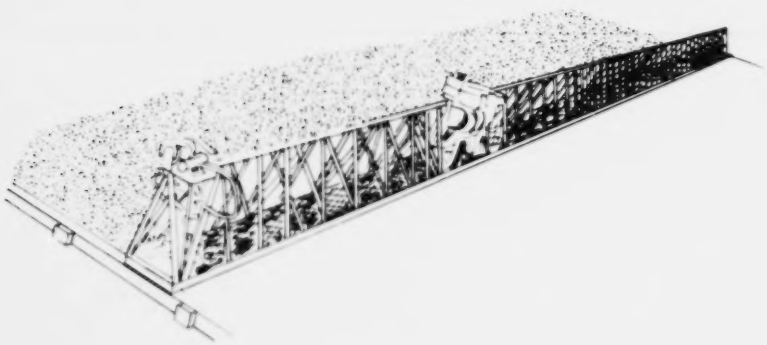


a. _____ b. _____

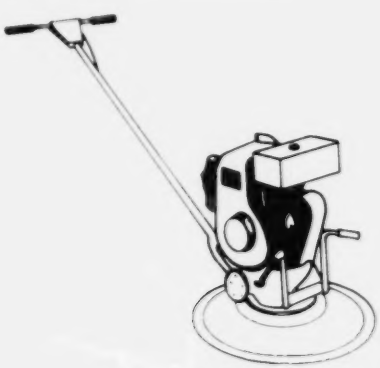
TEST



c. _____

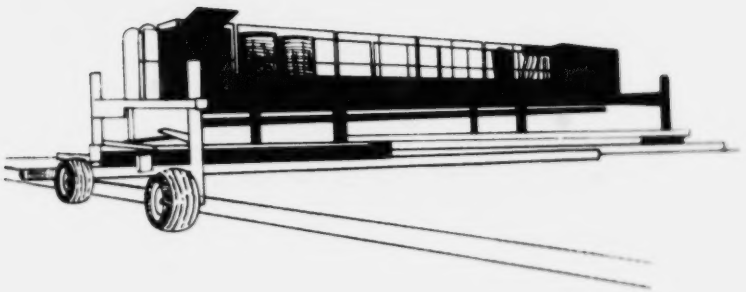


d. _____

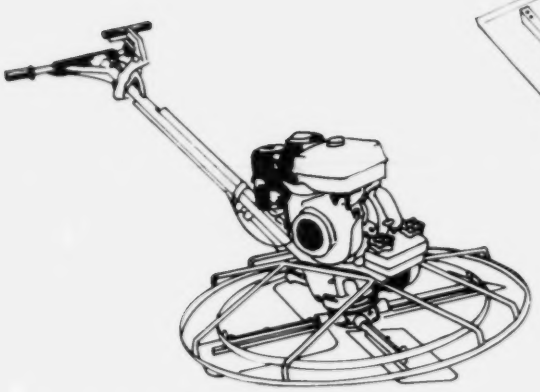


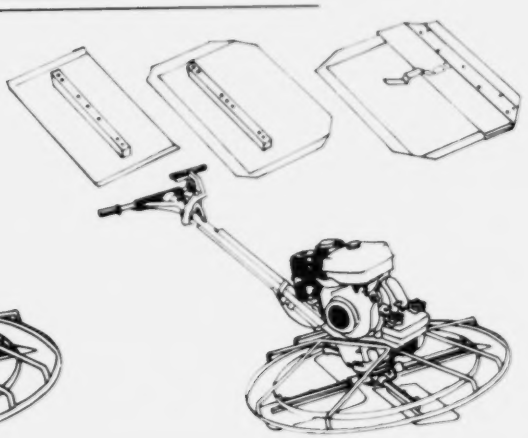
e. _____ f. _____

TEST

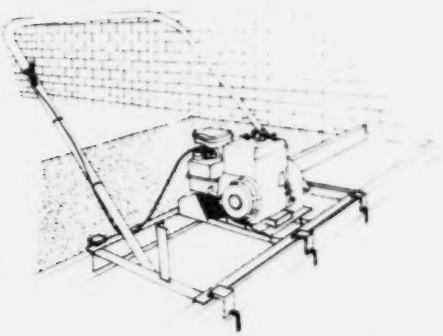


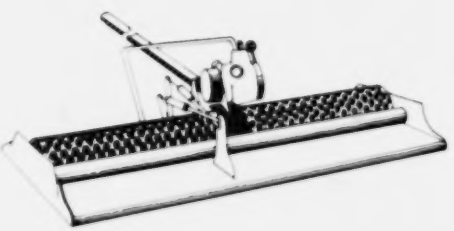
g. _____





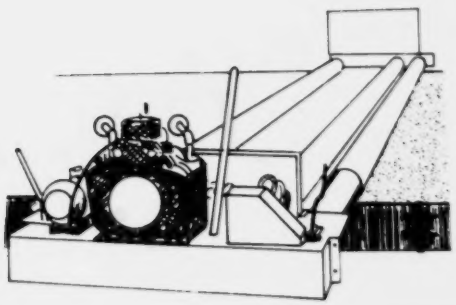
h. _____ i. _____

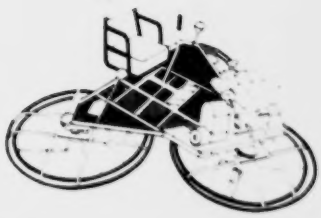




j. _____ k. _____

TEST





l. _____ m. _____

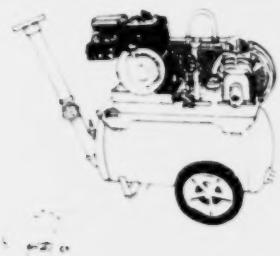
19. State two general uses of sprayers.

a. _____

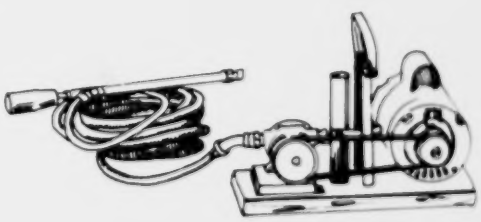
b. _____

20. Identify the types of power sprayers illustrated below. Write the correct answers in the blanks.

Electric-powered **Hand-held tank sprayer** **Gasoline-powered sprayer**



a. _____ b. _____



c. _____

TEST

21. State three general uses of power saws.

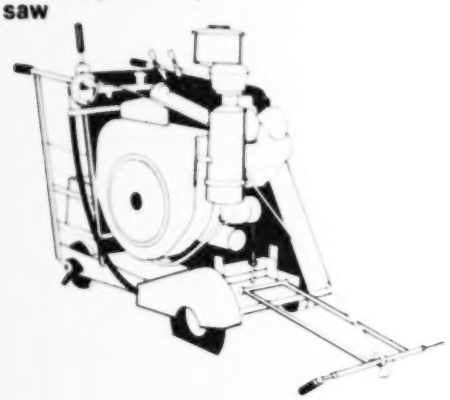
a. _____

b. _____

c. _____

22. Identify the types of power saws illustrated below. Write the correct names in the blanks.

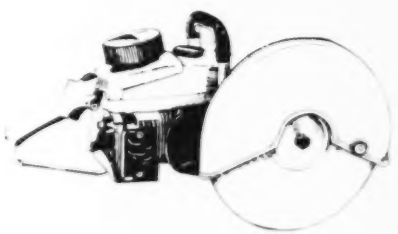
Medium-duty floor-type power saw



a. _____

_____

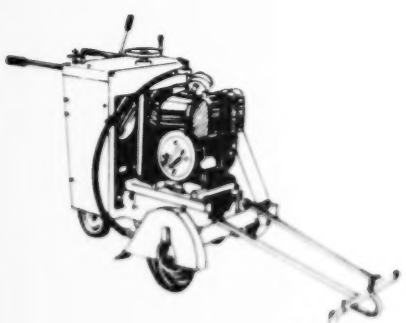
Portable electric-powered saw



b. _____

_____

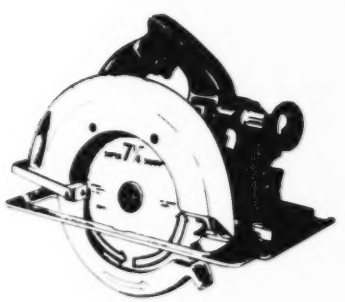
Portable gasoline-powered saw



c. _____

_____

Heavy-duty floor-type power saw



d. _____

_____

TEST

23. Match types of power grinders to their specific uses. Write the correct numbers in the blanks. Some blanks may contain more than one correct answer.

1. Hand-held electric-powered grinder
2. Portable, flexible-hose, direct-drive electric-powered grinder
3. Commercial-type floor grinder
4. Ceiling grinder
5. Portable, vibrator-type, gasoline powered grinder
6. Trowel machine with grinder head
7. Edge-and-base grinder

_____a. Used to rub and finish walls

_____b. Used to grind floors along obstructions and to finish concrete and terrazzo base

_____c. Used to remove seams and projections on walls

_____d. Used to remove projections on concrete-ceiling surface and to prepare ceiling for final finish

_____e. Used to grind high spots from floors and pavement and to grind floors prior to refinishing

24. Identify the types of power grinders illustrated below and on the following pages. Write the correct names in the blanks.

Edge-and-base grinder
Commercial-type floor grinder
Trowel machine with grinder head
Portable, flexible-hose, direct-drive, electric-powered grinder

Portable, vibrator-type, gasoline-powered grinder
Ceiling grinder
Hand-held electric-powered grinder

a. _____

_____

_____

b. _____

_____

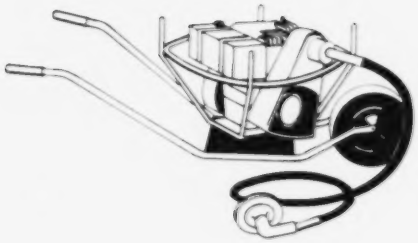
_____

TEST

c. _____

_____

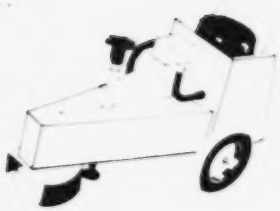
_____



d. _____

_____

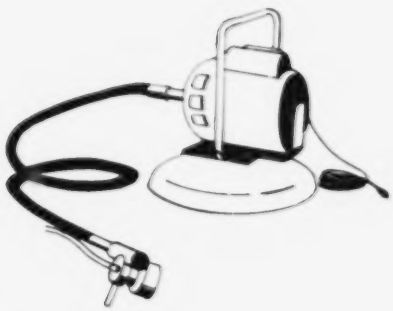
_____



e. _____

_____

_____

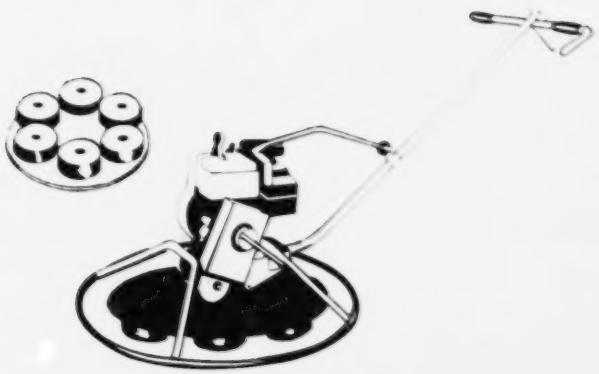


f. _____

_____

_____

TEST



g. _____

_____

_____

(NOTE: Test item 25 is the assignment sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

25. Complete a safety test pertaining to power tools.

CONCRETE TOOLS
UNIT II

ANSWERS TO TEST
PART I

1. a. 3
   b. 2
   c. 1
   d. 1
   e. 3
   f. 2
   g. 2
   h. 2
   i. 2
   j. 2

2. Answer should include any six of the following.

   a. Use the correct tool for the job
   b. Keep tools clean
   c. Maintain tools properly
   d. Keep tools sharp when appropriate
   e. Inspect tools frequently to make sure they are in good condition
   f. Repair broken or damaged tools promptly
   g. Dispose of broken tools that cannot be repaired
   h. *Do not* use broken tools
   i. *Do not* throw tools
   j. Protect cutting edge of tools when carrying and storing
   k. Store tools properly when not in use
   l. Wear eye, ear and nose protection when appropriate
   m. Stay alert when using hand tools

3. a. 1
   b. 3
   c. 2

4. a. 3
   b. 1
   c. 4
   d. 2

5. a. 1
   b. 2

6. a. 1
   b. 2

7. a. 3
   b. 4
   c. 1
   d. 2

8. a. 4
   b. 1
   c. 5
   d. 11
   e. 6
   f. 2
   g. 8
   h. 7
   i. 12
   j. 10
   k. 3
   l. 9

CONCRETE TOOLS
UNIT II

ANSWERS TO TEST
PART II

9.

a.	3	f.	2
b.	1	g.	1
c.	3	h.	1
d.	2	i.	3
e.	1	j.	3

10.
a. Shovels — Used to place and puddle concrete alongside edge forms to prevent voids and honeycombing
b. Straightedges — Used to rod concrete surface to a given grade
c. Darbies — Used to darby concrete surface to eliminate any high or low spots or ridges left after rodding process
d. Bullfloats — Used on large concrete surfaces to eliminate any high or low spots or ridges left after rodding process
e. Tampers (tamps) — Used on low-slump (1 inch or less) concrete to embed coarse aggregate just below concrete surface and to consolidate concrete surface
f. Edgers — Used to form a radius at concrete slab edges to improve appearance and reduce risk of damage to edges
g. Jointers (groovers) — Used to cut joints (grooves) partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance
h. Hand floats — Used to float concrete around hard-to-reach places and to prepare concrete surface for troweling
i. Trowels — Used to give concrete surface a dense, smooth finish
j. Combination tools — Used to do at least two jobs at the same time

11. **Types of straightedges**
a. Paver's (highway) straightedge
b. Common wood or magnesium straightedge
c. Long-handled, 12-foot, adjustable-head straightedge

Types of darbies
a. Long-handled magnesium darby
b. Small magnesium darby
c. Wood darby

Types of bullfloats
a. Wood bullfloat
b. Metal (magnesium or aluminum) bullfloat

ANSWERS TO TEST

Types to tampers
a. Rollerbug
b. Jitterbug
c. Hand tamper

Types of edgers
a. Long-handled walking-type edger
b. Curb edger
c. Pavement edger
d. Radius edger
e. Step-and-windowsill edger
f. Sidewalk edger

Types of jointers (groovers)
a. Small-bit hand-type jointer
b. Deep-bit hand-type jointer
c. Long-handled walking-type jointer

Type of hand floats
a. Special cork float
b. Common magnesium float
c. Special carpet float
d. Special rubber/sponge float
e. Common wood float

Types of trowels
a. Midget trowel
b. Finishing trowel
c. Pipe trowel
d. Fresno trowel

Types of combination tools
a. Step-and-sidewalk tool
b. Step-and-corner tool
c. Curb-and-gutter tool
d. Cove-and-base tool
e. Edger/jointer

12. a. Margin trowel
    b. Pointing trowel

13. a. Bush hammer
    b. Chipping hammer
    c. Rubbing stone

CONCRETE TOOLS
UNIT II

ANSWERS TO TEST
PART III

14.

a.	2	e.	2
b.	1	f.	2
c.	2	g.	1
d.	3	h.	1

15. Answer should include any eight of the following.

a. *Do not* attempt to operate any power tool without being certified by your instructor on that particular tool
b. Always wear appropriate safety equipment and protective clothing for job being done
c. *Do not* leave power tool running unattended
d. Assume a safe and comfortable position before starting a power tool
e. *Do not* distract others or let anyone distract you while operating a power tool
f. Be sure that electric power tool is properly grounded before using
g. Be sure that power tool is *not* running before performing maintenance or changing accessories
h. *Do not* use dull or broken accessories
i. Use power tool only for its intended use
j. *Do not* use a power tool with guards or safety devices removed
k. Use proper extension cord of sufficient size to service particular electric tool you are using
l. *Do not* operate electrical power tool if your hands or feet are wet
m. Before attempting to use it, be familiar with the correct operation and adjustment of power tool
n. Keep a firm grip on power-float or trowel-machine handle while operating machine
o. Be sure there is proper ventilation before operating gasoline-powered equipment indoors
p. Keep fire extinguisher handy when filling and operating gasoline-powered equipment
q. Lift heavy object with your legs—*not* with your back
r. Keep feet away from cutting tools such as concrete saws, grinders, and trowel-machine blades

16. a, c, e, i

17. a. Power straightedges — Used on various types of jobs to compact concrete, to bring concrete to desired grade, and to prepare concrete for finishing
b. Power tampers — Used to consolidate low slump (1 inch or less) concrete, to bring fines to the surface and to level the surface of the concrete

ANSWERS TO TEST

c. Power float machines — Used on flat concrete to consolidate concrete, to remove slight imperfections, to bring fines to the surface, to open concrete surface so that bleed water can escape, to work dry shake materials into surface, and sometimes to finish the surface of the concrete
d. Power finising machines — used to finish all types and sizes of concrete slabs

18. a. Hand-held power trowel
b. Vibrating bullfloat/tamper
c. Slip-form paver
d. Heavy-duty vibrating-type power straightedge
e. Pony trowel
f. Kelly float
g. Concrete finisher
h. Trowel machine
i. Trowel machine with blade attachments
j. Small portable power straightedge
k. Vibrating tamper (vibra tamp)
l. Roller type (tube-type) power straightedge
m. Riding trowel machine

19. Answer should include any two of the following.

a. To spray form oil on concrete forms
b. To spray curing compounds on finished concrete
c. To spray monomolecular film on fresh concrete to reduce rapid evaporation
d. To mist or fog finished concrete with water until suitable curing can take place

20. a. Gasoline-powered sprayer
b. Hand-held tank sprayer
c. Electric-powered sprayer

21. Answer should include any three of the following.

a. To cut control joints in concrete
b. To cut decorative joints in concrete
c. To cut out sections of concrete for replacement
d. To make cuts when demolishing concrete structures or slabs

22. a. Heavy-duty floor-type power saw
b. Portable gasoline-powered saw
c. Medium-duty floor-type power saw
d. Portable electric-powered saw

ANSWERS TO TEST

23. a. 2, 5
    b. 7
    c. 1
    d. 4
    e. 3, 6

24. a. Commercial-type floor grinder
    b. Ceiling grinder
    c. Hand-held electric-powered grinder
    d. Portable, vibrator-type, gasoline-powered grinder
    e. Edge-and-base grinder
    f. Portable, flexible-hose, direct-drive, electric-powered grinder
    g. Trowel machine with grinder head

25. Evaluated to the satisfaction of the instructor.

CONCRETE LAYOUT
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to use all tools and skills necessary to lay out a slab. The student should also be able to complete a checklist of a job prior to placing concrete. The student will show this ability by completing the assignment sheet, job sheets, and unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with concrete layout.
2. Select from a list types of tools and equipment for layout work.
3. Select from a list basic skills necessary to lay out a slab.
4. State common errors that contribute to inaccurate layout.
5. State items to look for when inspecting a job prior to placing concrete.
6. Demonstrate the ability to
   a. Use framing square and rule to lay out a square corner.
   b. Use a level.

CONCRETE LAYOUT
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Assignment Sheet #1 — Inspect Job and Complete a Checklist

E. Answers to Assignment Sheet #1

F. Job sheets

1. Job Sheet #1 — Use Framing Square and Rule to Lay Out a Square Corner

2. Job Sheet #2 — Use a Level

G. Test

H. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Equipment and materials for procedures outlined in the job sheets

2. Copies of checklist; Part II of Assignment Sheet #1

C. Introduce unit.

- Discuss types of tools and skills necessary to lay out a slab.
- Discuss the importance of accurate measurements, grades, and accurate form setting.
- Discuss common errors that contribute to inaccurate layout and items to look for when inspecting a job prior to placing concrete.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

SUGGESTED ACTIVITIES

F. Provide students with information, assignment, and job sheets.

G. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with concrete layout.

   - Show students examples illustrating terms, have the students give definitions of each of them.
   - Explain how knowing these terms and definitions will help the students to better understand the information presented in this unit.

2. Use Information Sheet, Section II, to discuss types of tools needed for layout work.

   - Show samples of the different types of tools.
   - Have students explain how each of the tools is used.

3. Use Information Sheet, Section III, to discuss basic skills necessary to lay out a slab.

   - Discuss the different basic skills necessary to lay out a slab; relate these skills to the tools used and the procedures in the job sheets.
   - Demonstrate procedures for the various skills listed in the information sheet.
   - Have students demonstrate procedures for various basic skills.

4. Use Information Sheet, Section IV, to discuss common errors that contribute to inaccurate layout.

   - Discuss and demonstrate how these errors are made and point out how they will affect the layout.
   - Have each student read a common error and then demonstrate the proper way the procedure should be done so that the error would not occur.

5. Use Information Sheet, Section V, to discuss items to look for when performing an inspection prior to placing concrete.

   - Have students review inspection items and then complete Part I of Assignment Sheet #1.
   - Take students to a construction site and have them make an inspection and complete the checklist in Part II of Assignment Sheet #1.

SUGGESTED ACTIVITIES

6. Demonstrate and discuss procedures outlined in Job Sheets #1 and #2.

7. Have students complete the job sheets.

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate section of competency profile.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

III. Unit reference — Hendrix, Laborn J. "Bud." *Concrete and Cement Masonry Skills*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

CONCRETE LAYOUT
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with concrete layout

A. **Layout** — Detailed plan, design, or arrangement of a project

B. **Scales** — Divisions or graduations found on the outer and inner edges of the framing square

C. **Slack** — Not tight; sagging

D. **Subgrade** — Soil prepared and compacted to support a structure or a pavement system

E. **Screed** — Temporary guide used to support straightedge when rodding concrete to an established grade

F. **Bulkhead** — Form used to cut off the concrete pour and to contain the concrete; sometimes used as a screed

G. **Burning forms** — Term used when reinforcing steel is touching forms

H. **Plumbing** — Process of determining true or exact vertical

II. Types of tools and equipment needed for layout work

A. Plans

B. Pencil

C. Folding rule or steel tape

D. Two 100-foot tapes

E. Framing square

F. Hand level or builder's level

G. Sledge hammer

H. Stakes

III. Basic skills necessary to lay out a slab

A. Ability to read and understand plans

B. Ability to use a folding rule or a steel tape to measure and lay out

INFORMATION SHEET

C. Ability to use a sledge hammer to drive stakes straight and plumb

D. Ability to use a hand level and builder's level to establish grade

E. Ability to use a hammer properly

F. Ability to use a framing square, rule, or tape properly

G. Ability to straighten, align, and brace forms

IV. Common errors that contribute to inaccurate layout

A. Leaving slack in tape

B. Aligning tape, rule or square improperly

C. Not placing end of tape or rule on reference point

D. Reading and recording incorrect numbers

E. Using a dull pencil

F. Not keeping square tight against workpiece

G. Not driving stakes properly

H. Not allowing for thickness of form material

I. Failure to recheck work

V. Items to look for when inspecting a job prior to placing concrete

A. Subgrade firm and on grade

B. Subgrade been wet down

C. Forms properly aligned and braced

D. Forms on grade

E. Screeds set at proper location for efficient placing and finishing of concrete

F. Screeds on grade

G. Bulkheads properly set and on grade

H. Reinforcing steel in place

I. Reinforcing properly placed; not protruding or burning forms

INFORMATION SHEET

J. Drains properly set with floor for proper drainage including holddown for tile

K. Expansion joint material in place and on grade

L. Grades on forms set for any recesses in floor

M. Concrete masons informed of specified finish

N. Finishing equipment available to the slab site

O. Curing materials and equipment available to the slab site

P. Barricade equipment available to slab site

Q. Fire extinguishers handy

CONCRETE LAYOUT
UNIT III

ASSIGNMENT SHEET #1 — INSPECT JOB AND COMPLETE CHECKLIST

NAME _____ SCORE _____

PART I

Visit a construction site prior to concrete placement and perform a site inspection. Then complete the following checklist.

Check appropriate blanks for each "yes" answer.

_____1. Is subgrade firm and on grade?

_____2. Has subgrade been wet down?

_____3. Are forms properly aligned and braced?

_____4. Are forms on grade?

_____5. Are bulkheads properly set and on grade?

_____6. Are screeds set at proper location for efficient placing and finishing of concrete?

_____7. Are screeds on grade?

_____8. Is reinforcing steel in place?

_____9. Is reinforcing steel properly placed, not protruding or burning forms?

_____10. Are drains properly set with floor for proper drainage?

_____11. Has allowance been made for holddown for tile at drains and cleanouts?

_____12. Is expansion joint material in place and on grade?

_____13. Are there any recesses in floor and have grades or forms been set for them?

_____14. Have concrete masons been informed of specified finish and any other special specifications?

_____15. Is finishing equipment at the slab site?

_____16. Are curing materials and equipment available to the slab site?

_____17. Is barricade equipment available to slab site?

_____18. Are fire extinguishers handy?

Comments:

_____

_____

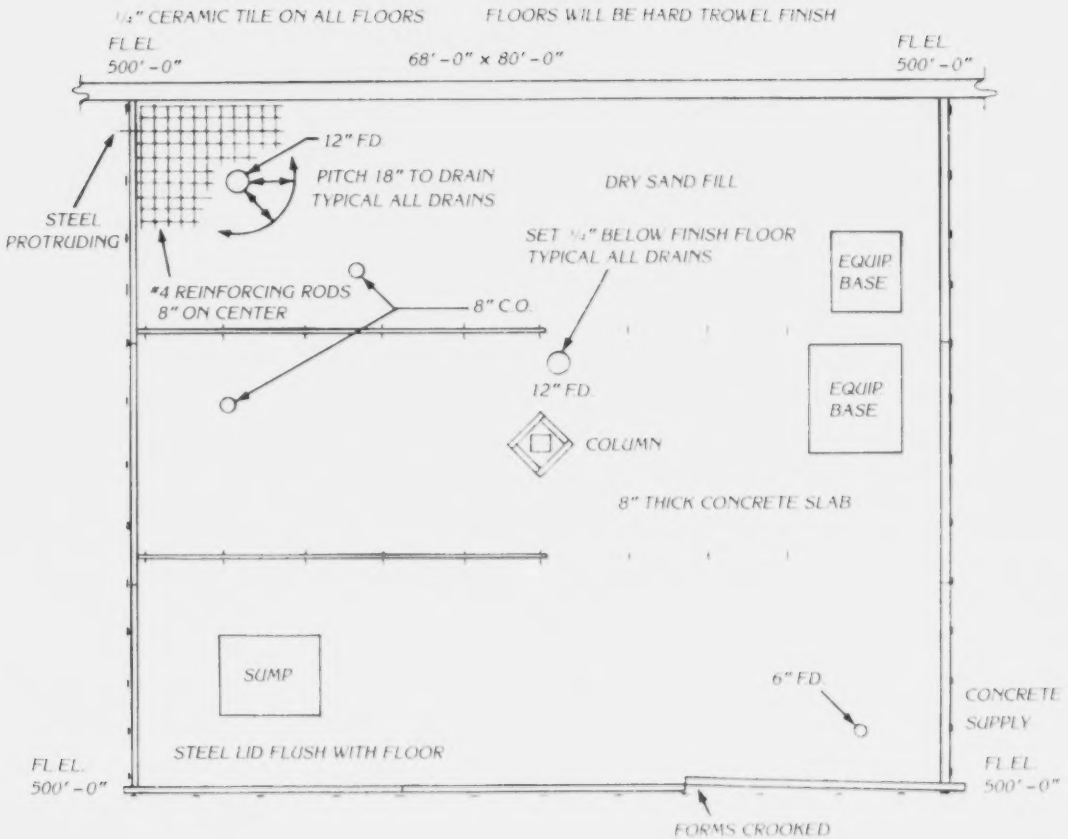
ASSIGNMENT SHEET #1

PART II

Using the job specifications shown on the next page, answer the following questions.

1. Is subgrade proper (on grade)? _____
2. Does subgrade need wetting down? _____
3. Are forms set correctly and adequately braced? _____
4. Is steel protruding or burning forms? _____
5. How many obstacles are there to work around? _____
6. How much fall and pitch are at drains? _____
7. What type of finish is specified? _____
8. Will floor covering be used and, if so, how much will you hold down around drains and clean outs? _____

ASSIGNMENT SHEET #1



CONCRETE LAYOUT
UNIT III

ANSWERS TO ASSIGNMENT SHEET #1

(NOTE: Because answers may vary considerably, they should be evaluated to the satisfaction of the instructor.)

PART I — Evaluated to the satisfaction of the instructor.

PART II

1. Yes
2. Yes
3. No
4. Yes
5. 9
6. 3/4", 18"
7. Hard trowel finish
8. Yes, 1/4"

CONCRETE LAYOUT
UNIT III

JOB SHEET #1 — USE FRAMING SQUARE AND RULE TO LAY OUT A SQUARE CORNER

I. Equipment and materials

A. Framing square

B. Pencil

C. 2 rules or 2 tapes

D. Chalk line

II. Procedure using framing square

A. Place framing square on point C to square off a line (See Figure 1)

(NOTE: Instructor will establish point C.)

B. Mark line CD along edge of framing square to establish square corner (Figure 1)

FIGURE 1

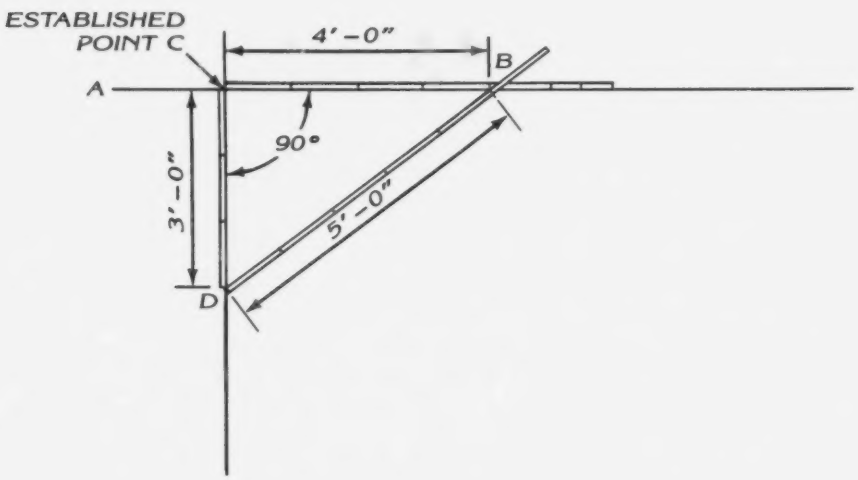
C. Snap a chalk line from point C along line CD to extend several feet past point D

JOB SHEET #1

III. Procedure using a rule

A. Start at point C and measure exactly 3 feet on line CD; mark this point (Figure 2)

FIGURE 2



B. Have an assistant place end of one rule exactly on point C; keep rule at a right angle to line CD and measure out 4 feet

C. Have another assistant place end of second rule exactly on the 3-foot mark on line CD, at an angle towards the 4-foot mark on line AB

D. Adjust the two rules until the 5-foot graduation on the second rule crosses the 4-foot graduation on the first rule; mark this point and remove both rules

E. Snap a chalk line from point C to point D and another from point C to point B, making sure the line passes directly through point where 4-foot and 5-foot measurements crossed

F. Recheck work

G. Clean work area, and properly store equipment and materials

CONCRETE LAYOUT
UNIT III

JOB SHEET #2 — USE A LEVEL

I. Equipment and materials

A. 4-foot spirit level

B. Vertical and horizontal work surfaces

C. Pencil

D. Tape

E. Straightedge

II. Procedure for leveling

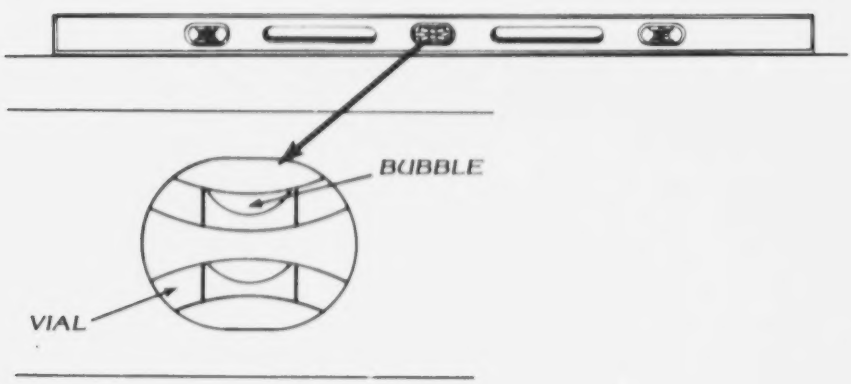
A. Check level for accuracy

(NOTE: Levels are very delicate instruments and must be handled carefully to ensure accuracy. Levels should be checked for accuracy before use, especially if the instrument has been dropped or jarred.)

1. Set base of level on flat, horizontal surface
2. Check bubble position in horizontal vial
3. Adjust surface or location of level until bubble is centered; mark position on surface

(NOTE: On a level surface, the bubble will lie evenly positioned between the lines on the vial. See Figure 3.)

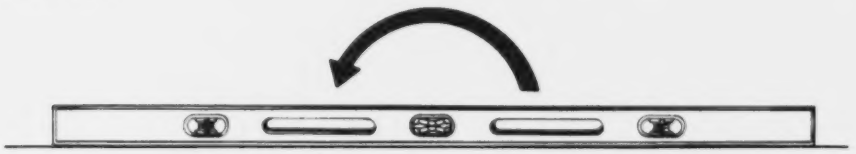
FIGURE 3



JOB SHEET #2

4. Rotate the level end for end and position it on the exact location of bubble-centered reading (Figure 4)

FIGURE 4



5. Check bubble position in the horizontal vial

   (NOTE: The bubble will be centered from this side also if the level is accurate.)

6. Replace or repair level as necessary

B. Level a surface

1. Visually check surface for irregularities and foreign matter such as dirt

   (NOTE: Even small surface irregularities or particles can cause inaccurate readings.)

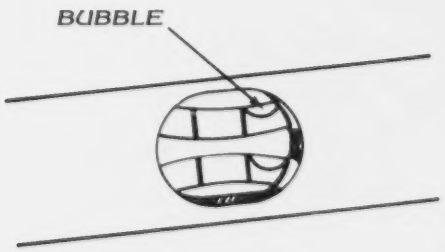
2. Clean or replace surface as necessary

3. Set base of level carefully and squarely on surface

4. Check bubble position

   (NOTE: The bubble will be displaced toward the high end of the level. See Figure 5.)

FIGURE 5



JOB SHEET #2

5. Adjust surface as necessary

6. Take additional readings to level surface as required

   (NOTE: Many factors, such as the type of surface and the material being used, affect the number of readings that are required.)

III. Procedure for plumbing

A. Check level for accuracy

1. Place base of level against flat, vertical surface (See Figure 6)

2. Check bubble position in upper horizontal vial

3. Adjust surface or location of level until bubble is centered; mark position on surface

4. Rotate level end for and position it on the exact location as that of the bubble-centered reading (Figure 7)

FIGURE 6

FIGURE 7

JOB SHEET #2

5. Check bubble position in the upper horizontal vial

   (NOTE: The bubble will be centered at this end also if level is accurate.)

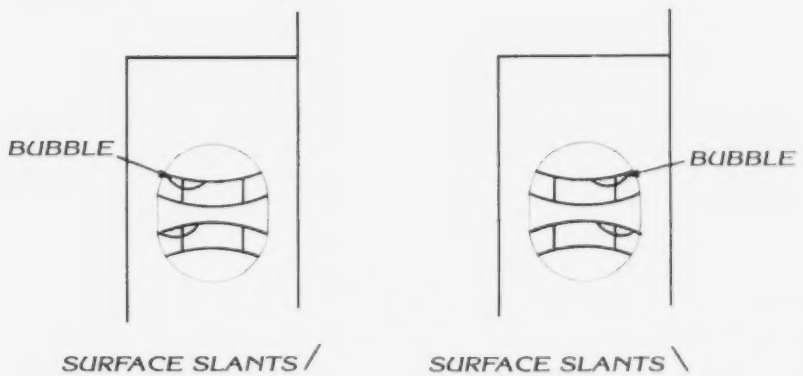
6. Replace or repair level as necessary

B. Plumb a surface

1. Visually check surface for irregularities and foreign matter such as dirt
2. Clean or replace surface as necessary
3. Place base of level carefully and squarely against surface
4. Check bubble position in upper vial

   (NOTE: The bubble will move toward one end of the vial if the surface is not plumb. To plumb the surface, you must adjust it in the direction of bubble displacement. See Figure 8.)

FIGURE 8



5. Adjust surface as necessary
6. Take additional readings to plumb as required

C. Clean work area, and properly store equipment and materials

CONCRETE LAYOUT
UNIT III

TEST

NAME _____ SCORE _____

1. Match terms and definitions associated with concrete layout. Write the correct numbers in the blanks.

_____a. Form used to cut off the concrete pour and to contain the concrete; sometimes used as a screed

_____b. Divisions or graduations found on the outer and inner edges of the framing square

_____c. Not tight; sagging

_____d. Term used when reinforcing steel is touching forms

_____e. Temporary guide used to support straightedge when rodding concrete to an established grade

_____f. Soil prepared and compacted to support a structure or a pavement system

_____g. Detailed plan, design, or arrangement of a project

_____h. Process of determining true or exact vertical

1. Subgrade
2. Bulkhead
3. Layout
4. Burning forms
5. Scales
6. Screed
7. Slack
8. Plumbing

2. Select from the following list tools and equipment needed for layout work. Write an "X" in the blank before each correct answer.

_____a. Chalk box and line

_____b. Framing square

_____c. Steel tape

_____d. Hand saw

_____e. Claw hammer

_____f. Hand level or builder's level

_____g. Sledge hammer

_____h. Forms

_____i. Stakes

_____j. Pencil

TEST

3. Select from the following list basic skills necessary to lay out a slab. Write an "X" in the blank before each correct answer.

   _____a. Ability to use a sledge hammer to drive stakes straight and plumb

   _____b. Ability to straighten, align, and brace forms

   _____c. Ability to use float and trowel to finish a slab

   _____d. Ability to use a folding rule or a steel tape to measure and lay out

   _____e. Ability to use a framing square, rule, or tape properly

   _____f. Ability to read and understand plans

   _____g. Ability to use a hammer properly

   _____h. Ability to use a hand level and builder's level to establish grade

4. State four common errors that contribute to inaccurate layout.

   a. _____

   b. _____

   c. _____

   d. _____

5. State eight items to look for when inspecting a job prior to placing concrete.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

TEST

(NOTE: Test item 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

   a. Use a framing square and rule to lay out a square corner.

   b. Use a level.

CONCRETE LAYOUT
UNIT III

ANSWERS TO TEST

1.

a. 2	c. 7	e. 6	g. 3
b. 5	d. 4	f. 1	h. 8

2. b, c, f, g, i, j

3. a, b, d, e, f, g, i

4. Answer should include any four of the following.

   a. Leaving slack in tape
   b. Aligning tape, rule or square improperly
   c. Not placing end of tape or rule on reference point
   d. Reading and recording incorrect numbers
   e. Using a dull pencil
   f. Not keeping square tight against workpiece
   g. Not driving stakes properly
   h. Not allowing for thickness of form material
   i. Failure to recheck work

5. Answer should include any eight of the following.

   a. Subgrade firm and on grade
   b. Subgrade been wet down
   c. Forms properly aligned and braced
   d. Forms on grade
   e. Screeds set at proper location for efficient placing and finishing of concrete
   f. Screeds on grade
   g. Bulkheads properly set and on grade
   h. Reinforcing steel in place
   i. Reinforcing properly placed; not protruding or burning forms
   j. Drains properly set with floor for proper drainage including holddown for tile
   k. Expansion joint material in place and on grade
   l. Grades or forms set for any recesses in floor
   m. Concrete masons informed of specified finish
   n. Finishing equipment available to the slab site
   o. Curing materials and equipment available to the slab site
   p. Barricade equipment available to slab site
   q. Fire extinguishers handy

6. Performance skills evaluated to the satisfaction of the instructor.

CONCRETE BASIC SKILLS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to perform various basic skills, should be able to identify factors to look for prior to finishing concrete and should know what steps to take when placing and finishing concrete. The student will show this ability by completing the job sheets and unit test with a minimum score of 80 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with concrete basic skills.
2. State basic skills necessary to construct forms, place and finish concrete.
3. Distinguish between edge forms, bulkheads, and screeds according to their characteristics.
4. Distinguish between placing and rodding.
5. Arrange in order steps to take when placing and finishing a concrete slab.
6. State factors to look for prior to starting finishing procedures.
7. Demonstrate the ability to
   a. Set and drive nails with a nail hammer.
   b. Use a crosscut handsaw.
   c. Construct edge forms for a sidewalk.
   d. Construct edge forms for a slab on grade.
   e. Use a bullfloat.
   f. Use a hand float and finishing trowel.
   g. Use an edger.
   h. Operate a power trowel machine.
   i. Operate an electric sprayer.

CONCRETE BASIC SKILLS
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job sheets
  1. Job Sheet #1 — Set and Drive Nails with a Nail Hammer
  2. Job Sheet #2 — Use a Crosscut Handsaw
  3. Job Sheet #3 — Construct Edge Forms for a Sidewalk
  4. Job Sheet #4 — Construct Edge Forms for a Slab on Grade
  5. Job Sheet #5 — Use a Bullfloat
  6. Job Sheet #6 — Use a Hand Float and Finishing Trowel
  7. Job Sheet #7 — Use an Edger
  8. Job Sheet #8 — Operate a Power Trowel Machine
  9. Job Sheet #9 — Operate an Electric Sprayer
- E. Test
- F. Answers to test

II. Instructor's guide

- A. Review unit and plan presentation.
- B. Obtain materials to supplement unit.
  1. Equipment and materials for procedures outlined in the job sheets
  2. Resource materials

     (NOTE: When ordering books and films, order the latest editions.)

     a. Books

        1) *Building Concrete Walks, Driveways, Patios, and Steps*, 1979.

        2) *Cement Masons Guide*, 1980.

3) *Transporting and Handling Concrete.*

(NOTE: The above books are available from Portland Cement Association, Ordering Processing, 5420 Old Orchard Road, Skokie, Illinois 60077-4321.)

b. Audiovisual materials

(NOTE: The following audiovisual materials are available from Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077-4321.)

1) *Transporting and Placing Quality Concrete*, 16 mm film (PC 199) or video cassette (VC 199), 27 min., 1976.

(NOTE: This film is about recommended techniques and equipment used to transport concrete, conveyance devices, preparation, placing, consolidating, and hot and cold weather placing practices.)

2) *Mr. Quality Concrete* (SS 002), 40 slides.

(NOTE: This slide show presents fundamental principles of concrete technology, mix proportions, transporting, placing, and finishing.)

3) *Finishing Concrete Flatwork*, videotape cassette, 31 minutes, 1984.

(NOTE: This cassette shows demonstrations of basic procedures for finishing concrete flatwork, utilizing proper tools and techniques as recommended by ACI and expert finishers. Also covers subgrade and formwork preparations, concrete placement, jointing, curing and special finishes. Emphasizes important "do's" and "don'ts.")

C. Introduce unit.

- Discuss basic skills, forms and screeds, and steps to take when placing and finishing concrete slabs.
- Show examples of various types of edge forms, bulkheads, and screeds; explain their differences and why each type is chosen for a particular job.
- Relate the basic skills to the steps used when placing and finishing concrete as well as to the procedures outlined in the job sheets.
- Use American Concrete Institute and Portland Cement Association materials to introduce this unit.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, pointing out how the objectives relate to each other.

F. Provide students with information and job sheets.

G. Discuss information and job sheets.

1. Use Information Sheet, Section I, to review the terms and definitions associated with concrete basic skills.

   - Relate the terms to their use in the unit.
   - Show students samples or examples to illustrate appropriate terms.
   - Discuss the importance of understanding the terms and definitions and how they relate to this unit.

2. Use Information Sheet, Section II, to discuss basic skills necessary to construct forms, place and finish concrete.

   - Discuss the different skills necessary to construct, place and finish concrete; relate these skills to the steps to take when placing and finishing a concrete slab and to the procedures outlined in the job sheets.
   - Discuss the safety guidelines that the students should be aware of when practicing the basic skills.

3. Use Information Sheet, Section III, to discuss the characteristics of edge forms, bulkheads, and screeds.

   - Discuss how all three of these can be used as guides for rodding concrete and how each of them serve a different purpose.
   - Show students examples of different types of edge forms, screeds, and bulkheads; explain where and how the various types are used.
   - Emphasize the importance of edge forms, bulkheads, and screeds being set to grade and how edge forms and bulkheads should be strong enough to contain the concrete.

4. Use Information Sheet, Section IV, to discuss the difference between placing and rodding.

   - Explain the difference between placing and rodding.
   - Demonstrate rodding procedures.
   - Explain how quite often people refer to concrete being poured which is not true unless they are using very wet concrete; concrete should be placed, not poured.

SUGGESTED ACTIVITIES

5. Use Information Sheet, Section V, to discuss the steps to take when placing and finishing a concrete slab.

   - Review the steps from the information sheet, then have students enact the steps; start with one student enacting the first step, then another student the second. If the student does the wrong step, stop and call on another student to enact the correct one and so on.

   - Take a field trip to a job site so students will have the opportunity to watch workmen actually performing these procedures.

6. Use Information Sheet, Section VI, to discuss the factors to look for prior to starting finishing procedures.

   - Explain these factors to the students, then while on your field trip, try to point out each of these factors to the students.

   - Have students talk to the concrete masons, asking them how they know when to start finishing procedures. The students will probably find that this is something they will have to learn over a long period of time.

7. Demonstrate and discuss procedures outlined in Job Sheets #1 through #9.

8. Have students demonstrate the procedures, then have them complete the job sheets.

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate section of competency profiles.

(NOTE: A master of the competency profile for this book is provided at the front of the instructor edition. You may duplicate the profile and distribute it to students as needed.)

III. Unit references

A. Hendrix, Laborn J. "Bud", *Fundamentals of Concrete and Cement Masonry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

B. Hendrix, Laborn J. "Bud", *Concrete and Cement Masonry Skills.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1987.

CONCRETE BASIC SKILLS
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with concrete basic skills

A. **Lay down concrete** — Term used meaning to float and trowel surface of a concrete slab the first time

B. **Concrete set** — Attainment of significant rigidity

C. **Slack** — Not tight; sagging

D. **Flush** — Even with; having or forming a continuous plane or unbroken surface

E. **Spreader** — Piece of wood inserted between forms to temporarily hold forms the proper distance apart

F. **Scab** — Piece of material fastened across a splice or joint to strengthen and hold the two pieces together

G. **Kerf** — Shallow saw-cut in which to fit line to hold it in place

H. **Curing compound** — Liquid coating applied to newly placed concrete to maintain a satisfactory moisture content and favorable temperature in concrete during the early stages so that desired properties may develop

II. Basic skills necessary to construct forms, place and finish concrete

A. Ability to use a rule and tape accurately

B. Ability to use a square accurately

C. Ability to use a nail hammer properly

D. Ability to use a handsaw properly

E. Ability to drive stakes straight and plumb with a sledge hammer

F. Ability to use a hand level and a builder's level properly and accurately

G. Ability to rod concrete level

H. Ability to use a bullfloat properly

I. Ability to use a float and trowel to lay down concrete

J. Ability to use an edger to finish edges of concrete

INFORMATION SHEET

K. Ability to use a jointer to cut joints in concrete

L. Ability to use a power trowel machine to lay down concrete

M. Ability to use a hand trowel to finish concrete

N. Ability to use a power trowel machine to finish concrete

O. Ability to use a power sprayer to apply curing compound

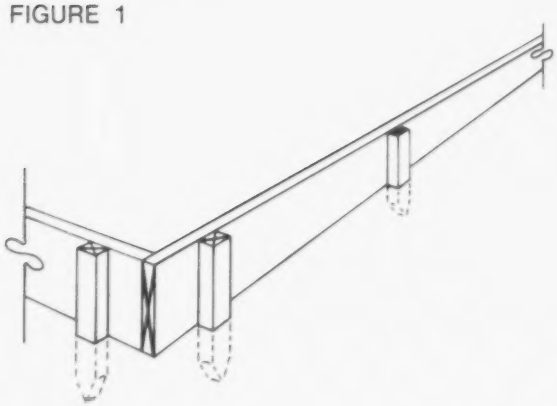
III. Characteristics of edge forms, bulkheads, and screeds (Figures 1-3)

A. Edge forms

1. Low forms placed at perimeter of slab to contain the concrete
2. Used to limit horizontal spread of fresh concrete
3. Removed after concrete has set

EXAMPLE:

FIGURE 1



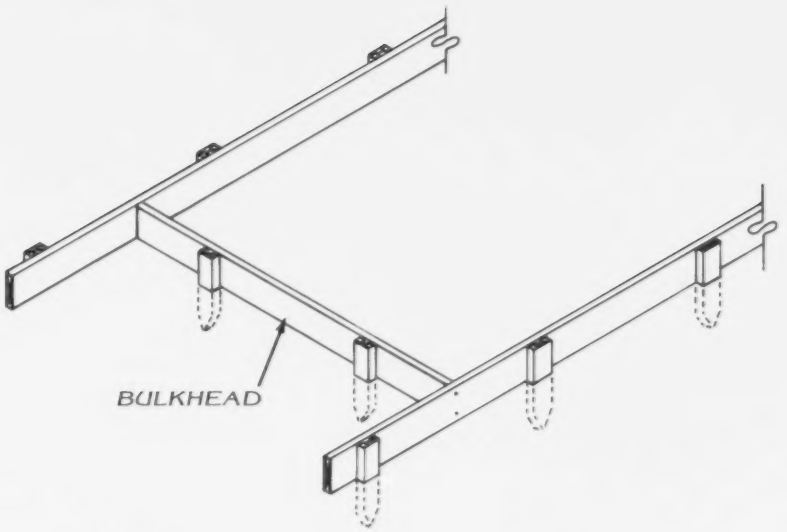
B. Bulkheads

1. Forms used to contain concrete and to cut off concrete pour
2. Sometimes used as a guide when rodding concrete to established grade
3. Removed after concrete has set

INFORMATION SHEET

EXAMPLE:

FIGURE 2



C. Screeds

1. Temporary guides used to support straightedge when rodding concrete to an established grade

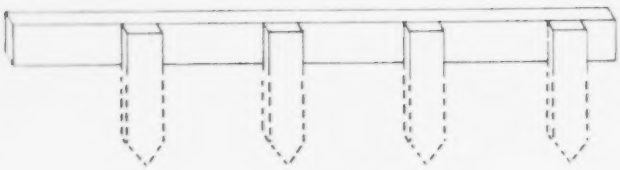
2. Usually set no more than 12 feet apart

3. Removed after concrete is placed

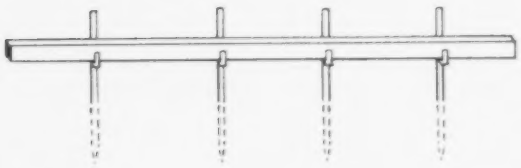
INFORMATION SHEET

EXAMPLES:

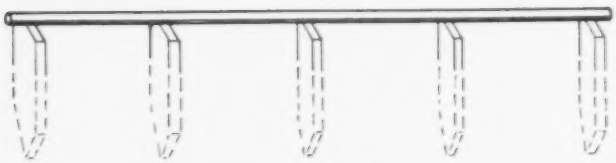
FIGURE 3



WOOD



SQUARE TUBE



ROUND PIPE

IV. Placing versus rodding

A. Placing — Process of delivering concrete from the supply and placing it at the established area inside the forms

B. Rodding — Process of leveling concrete to an established grade

V. Steps to take when placing and finishing a concrete slab

A. Place concrete

B. Rod or straightedge

C. Bullfloat or darby

D. Hand float

E. Edge

F. Trowel

INFORMATION SHEET

G. Cut joints when appropriate

H. Re-edge

I. Finish

J. Apply curing compound

VI. Factors to look for prior to starting finishing procedures

A. Concrete hardening

(NOTE: The concrete should be hard enough to support the weight of an average size person, leaving only slight footprints on the surface.)

B. Bleed water should be gone

C. Water sheen should be gone

D. Glossy appearance not noticeable

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #1 — SET AND DRIVE NAILS WITH A NAIL HAMMER

I. Tools and equipment

A. Nail hammer (curved-claw or straight-claw hammer)

B. Nails

C. Two pieces of wood

D. Firm, steady work surface

II. Procedure

A. Check hammer to be sure that it is in good condition and handle is tight

B. Place two pieces of wood, one on top of the other, on work surface (See Figure 5)

C. Hold nail upright on top piece of wood with one hand (See Figure 5)

D. Set nail, using the following guidelines

1. Grasp hammer firmly near end of handle (See Figure 4)

2. Rest face of hammer on nailhead (See Figure 5)

3. Lift hammer and then give nail a light tap (Figure 5)

FIGURE 4

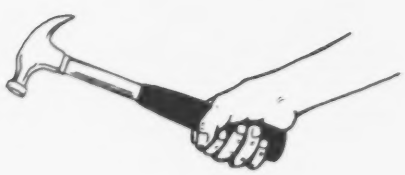


FIGURE 5

JOB SHEET #1

E. Drive nail, using the following guidelines

1. Strike nail squarely with firm, smooth swing of hammer

   (NOTE: Deliver blows smoothly and evenly, using wrist, elbow, and/or shoulder—one or all are brought into action depending on the required force of the blow to be struck.)

2. Avoid marring wood or bending nail

3. If nail bends, pull it out and start again

4. Continue driving nail until it penetrates top piece of wood, but stop before it enters bottom piece of wood

F. Following the procedures in Steps D and E, continue practicing until you can set and drive nails without bending them

G. Clean work area, and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #2 — USE A CROSSCUT HANDSAW

I. Tools and equipment

A. Crosscut handsaw

B. Square

C. Pencil

D. Piece of wood

E. Sawhorse

II. Procedure

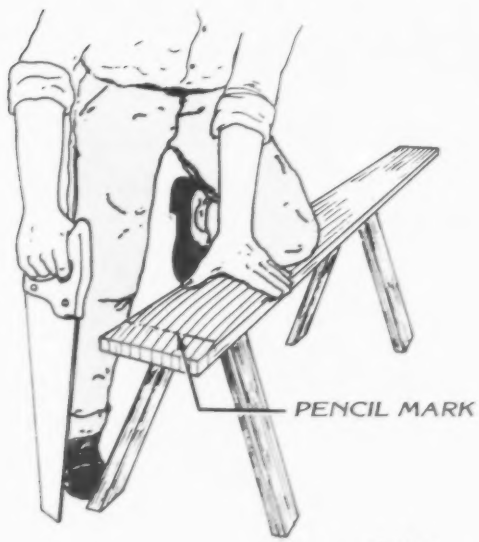
A. Check saw to be sure it is sharp and in good condition

B. Square and mark a pencil line across wood near one end (See Figure 6)

C. Lay wood on sawhorse so that pencil mark extends past end of sawhorse (See Figure 6)

D. Place one knee on top of wood to hold it firmly in place on sawhorse; grasp saw in one hand (Figure 6)

FIGURE 6

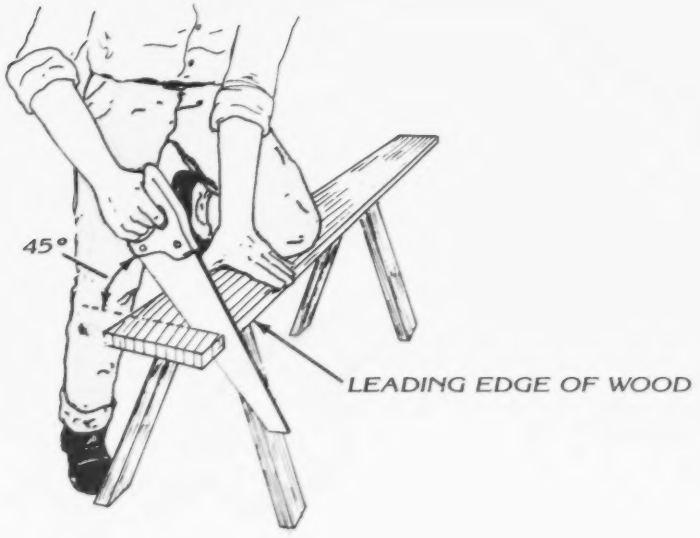


JOB SHEET #2

E. Start and complete cut, using the following guidelines

1. Place saw on leading edge of wood at pencil mark
2. Slide your thumb next to blade to steady blade and hold it on pencil mark
3. Draw saw backward and then push saw forward to start cut, holding saw at about a 45-degree angle from surface of wood (Figure 7)

FIGURE 7



4. Draw saw backwards, holding blade square to piece of wood
5. Continue forward-and-backward motions until wood is cut through

(NOTE: Do not force, twist, or bend saw as this will damage the blade.)

F. Clean work area, and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #3 — CONSTRUCT EDGE FORMS FOR A SIDEWALK

I. Tools and materials

A. Sledge hammer

B. Claw hammer

C. Power handsaw and proper extension cord

> **CAUTION**
> Wear eye protection when operating power handsaw.

D. Handsaw

E. 100-foot tape

F. Folding rule or steel tape

G. Hand level

H. String line

I. Builder's level and rod

J. Stakes

K. 2×4s for sheathing

L. 8d and 16d duplex nails

II. Procedure

(NOTE: The sidewalk will be 4′-0″ × 24′-0″ × 4″.)

A. Establish sidewalk location

(NOTE: Check with your instructor.)

B. Set form stakes for one side of sidewalk

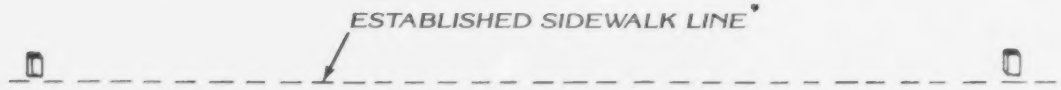
1. Locate side you are going to set first

2. Drive line stakes at each end of this side, approximately 24 feet apart (See Figure 8)

(NOTE: Be sure to allow for thickness of the forms when setting line stakes.)

JOB SHEET #3

FIGURE 8

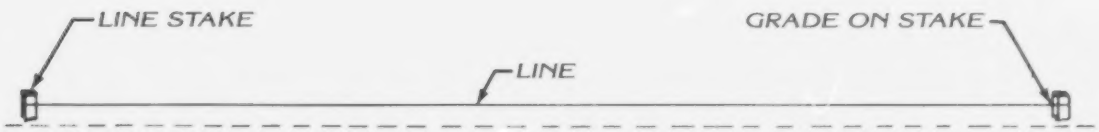


3. Establish sidewalk grade on the two line stakes

4. Secure line to one line stake on established grade and stretch line tight to the established grade on end stake (Figure 9)

   (NOTE: Be sure that line is tight and does not sag.)

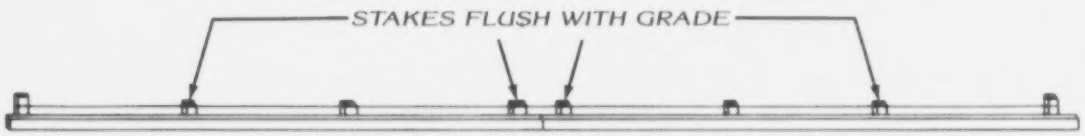
FIGURE 9



5. Lay out sheathing for this section of the sidewalk, starting at one end and laying boards end to end

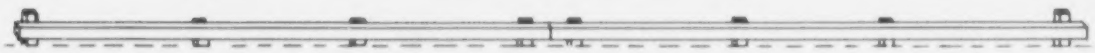
6. Drive all intermediate stakes 3 to 3 ½ feet apart, straight down with face of stake plumb with line and top of stake flush with line (Figure 10)

FIGURE 10



C. Nail 2×4 sheathing to stakes with top of 2×4 flush with grade (Figure 11)

FIGURE 11



JOB SHEET #3

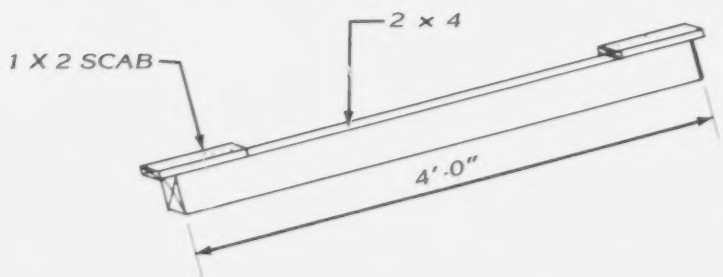
D. Align form and brace if necessary

E. Construct two spreaders for positioning opposite side of sidewalk form. (Figure 12)

(NOTE: Spreader can also be used to establish the subgrade.)

1. Cut 2×4 into two 4-foot lengths
2. Nail 1×2 scab to each end of both spreaders with end of scab extending beyond spreader end

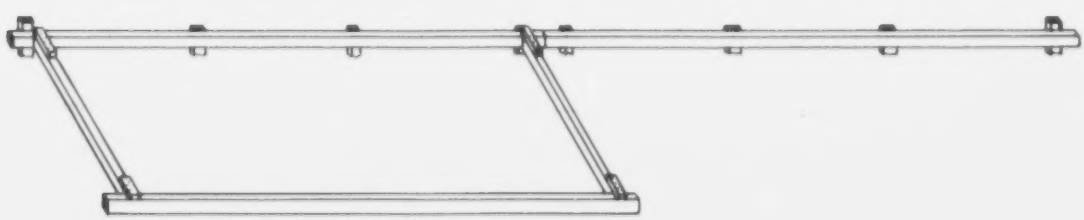
FIGURE 12



F. Set form stakes for opposite side of sidewalk

1. Lay out 2×4 sheathing for this side of sidewalk, starting even with one end of completed form and laying 2×4s end to end
2. Lay spreaders between erected form and sheathing snugging them together (Figure 13)

FIGURE 13



3. With sheathing in place, drive stakes opposite those in erected form; drive stakes straight down with solid blows of the sledge hammer

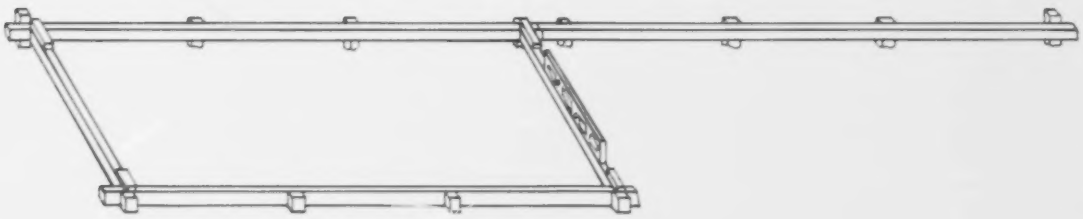
(NOTE: If the stakes are not driven straight down, the completed form will be forced out of alignment.)

JOB SHEET #3

4. Establish grade by placing hand level on top of spreader board (Figure 14)

   (NOTE: Check with instructor for grade on this form.)

FIGURE 14



5. Drive stakes down to grade
6. Nail 2×4 sheathing to stakes with top of form flush with top of stake
7. Repeat steps 2 through 6 for entire length of sidewalk

G. Align second side of the form, maintaining 4′-0″ between the two sides

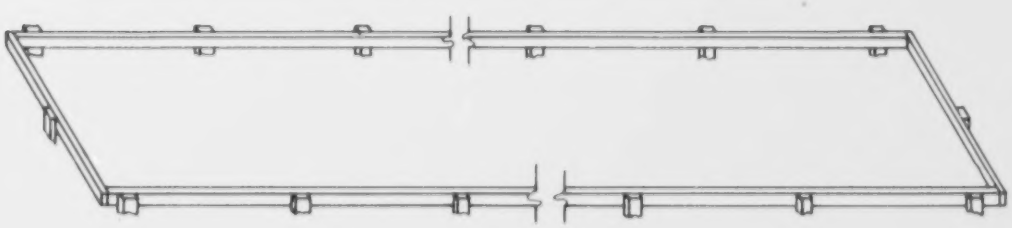
H. Cut two 2×4s long enough (at least 4′-3″) to go across ends of forms for bulkheads

I. Nail bulkheads in place, with tops of bulkheads flush with top of both side forms

J. Drive a stake at the center of each bulkhead to keep concrete from forcing bulkheads out (Figure 15)

   (NOTE: A scab can be nailed across the joint where the two forms butt each other or they may be toenailed together.)

FIGURE 15



K. Have instructor inspect your work

L. Clean work area and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #4 — CONSTRUCT EDGE FORMS FOR A SLAB ON GRADE

I. Tools and materials

A. Sledge hammer

B. Claw hammer

C. Power handsaw and proper extension cord

> **CAUTION**
> Wear eye protection when operating power handsaw.

D. Handsaw

E. 100-foot tape

F. Folding rule or steel tape

G. Hand level

H. Chalkline

I. Builder's level and rod

J. Plumb bob

K. Stakes

L. 2×10s for sheathing

M. 8d and 16d duplex nails

N. String line

II. Procedure

A. Perform site layout

(NOTE: Refer to *Fundamentals of Concrete and Cement Masonry*, Section D, Unit V, "Leveling Instruments," if necessary.)

B. Offset lines on batter boards the thickness of the forms (1 1/2 inches) and mark; saw a kerf in each ledger board at the exact location to keep line from shifting

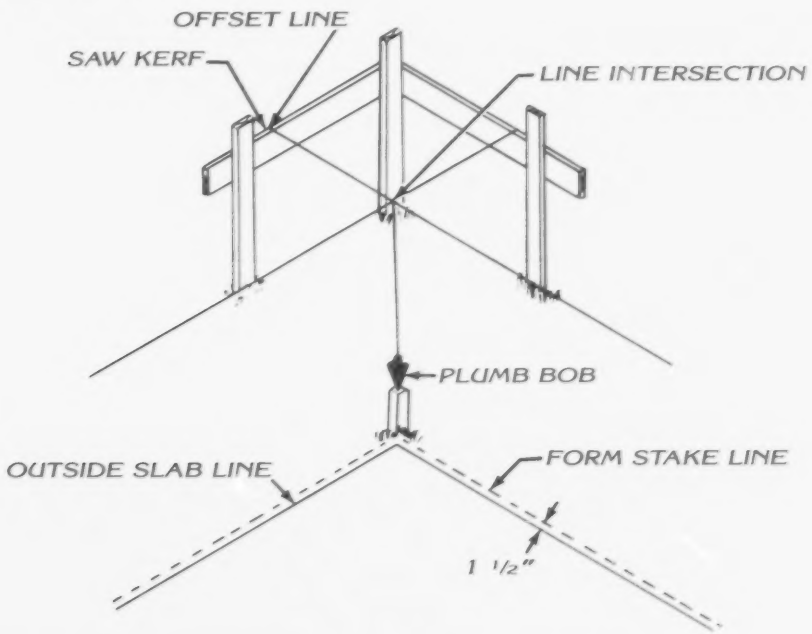
C. Secure line to batter boards at the saw kerf

JOB SHEET #4

D. Attach plumb bob to line intersection

E. Drive corner form stake and set a nail exactly at point of plumb bob (Figure 16)

FIGURE 16



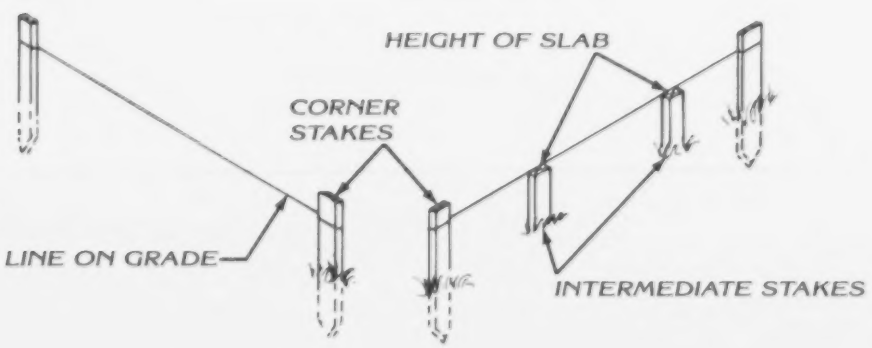
F. Repeat Steps D and E on remaining three corners

G. Establish grade on all corner stakes

H. Secure line to first corner stake on established grade and stretch line tight to established grade on next corner stake (Figure 17)

(NOTE: Be sure that the line is tight and does not sag.)

FIGURE 17

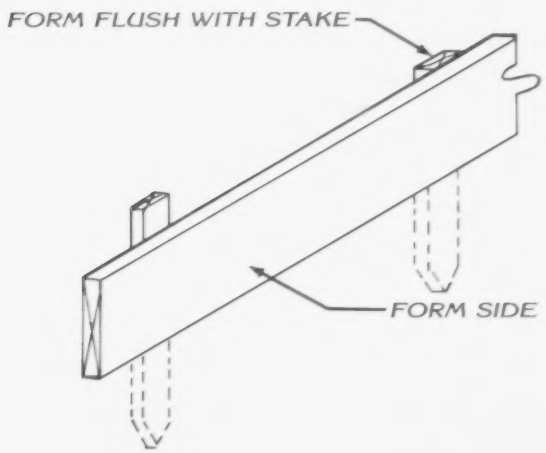


JOB SHEET #4

I. Drive all intermediate stakes straight down, with face of stakes plumb with line and top of stakes flush with line (See Figure 17)

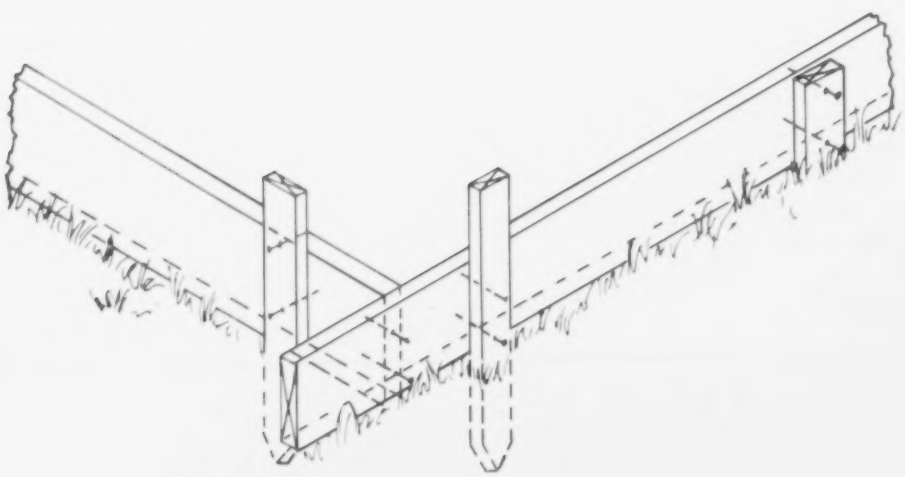
J. Nail 2×10 sheathing to stakes with top of 2×10 flush with grade on stakes (Figure 18)

FIGURE 18



K. Tie all corners together using duplex nails (Figure 19)

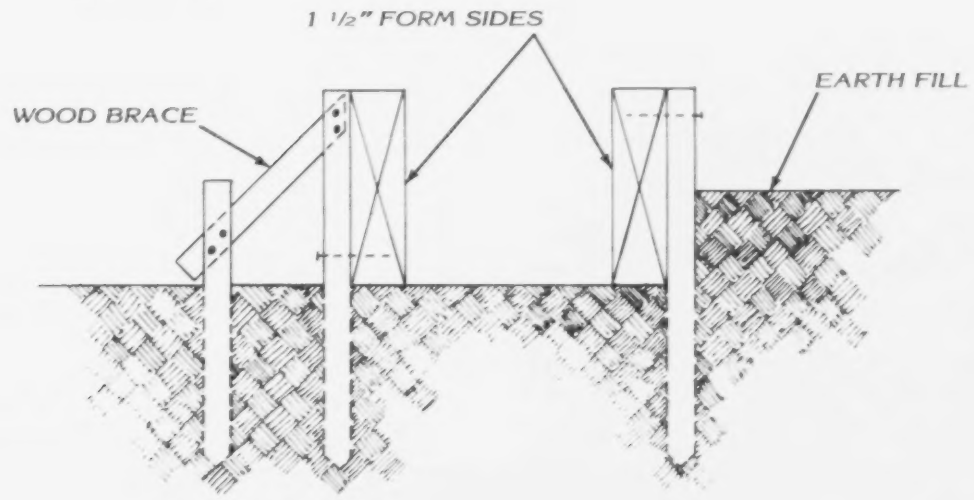
FIGURE 19



JOB SHEET #4

L. Brace forms with wood braces or earth fill (Figure 20)

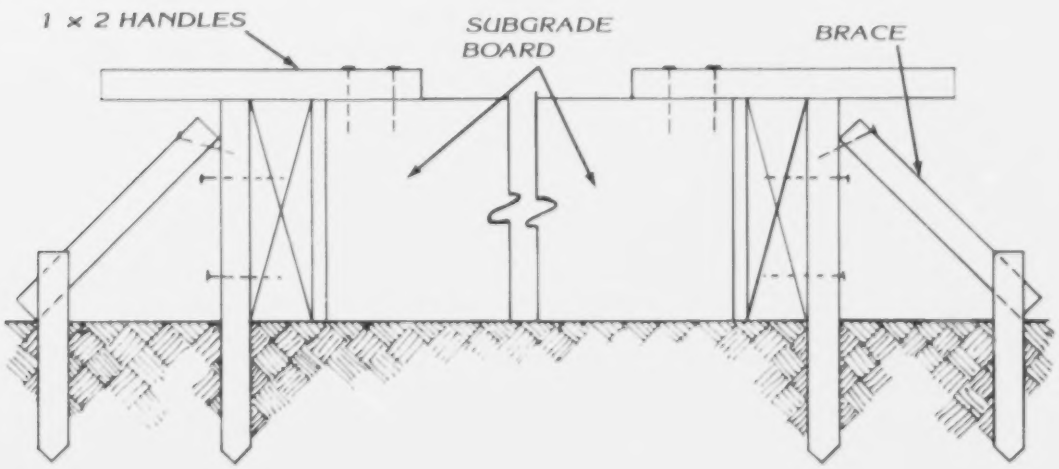
FIGURE 20



M. Make grade board as shown in Figure 21

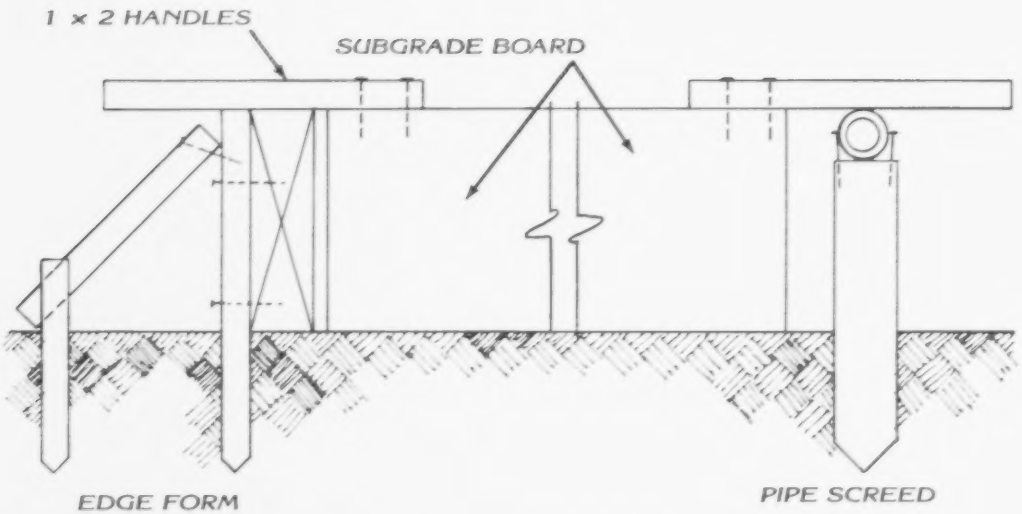
(NOTE: Grade board will be used to establish elevation of the subgrade. On wide structures, it will be necessary to set a temporary screed; see Figure 22.)

FIGURE 21



JOB SHEET #4

FIGURE 22



N. Have instructor inspect your work

O. Clean work area and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #5 — USE A BULLFLOAT

I. Tools and equipment

A. Bullfloat

B. Concrete or sand pad

C. Protective clothing

II. Procedure

(NOTE: Bullfloating is done immediately after the concrete has been straightedged. When possible, bullfloat in a direction that is perpendicular to the direction of the straightedging process.)

A. Adjust bullfloat handle to your reach (so that the bullfloat will be comfortable for you to use)

B. Make first pass

1. Set bullfloat blade on edge of concrete

2. Position bullfloat handle low enough so that leading edge of blade (Point A) is raised slightly (Figure 23)

FIGURE 23

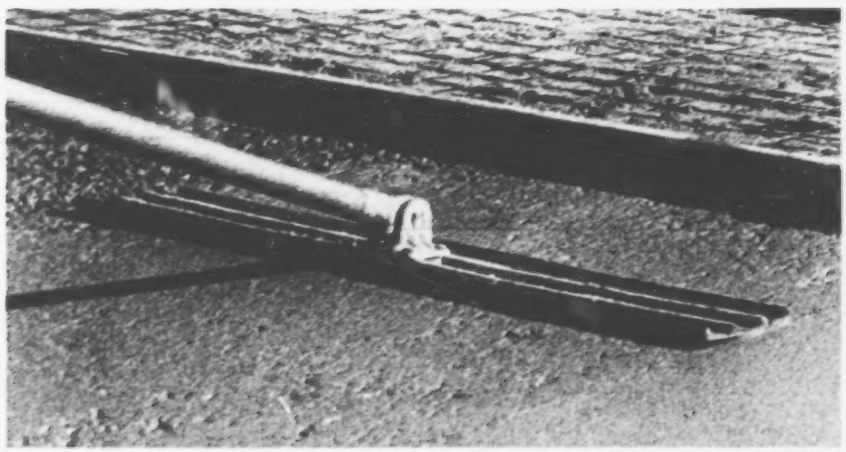
JOB SHEET #5

3. Begin forward stroke by pushing and sliding bullfloat across slab while keeping handle low enough to maintain slightly raised leading edge of blade

4. As you near end of forward stroke, jiggle bullfloat slightly while raising bullfloat handle to flatten blade against concrete surface (Figure 24)

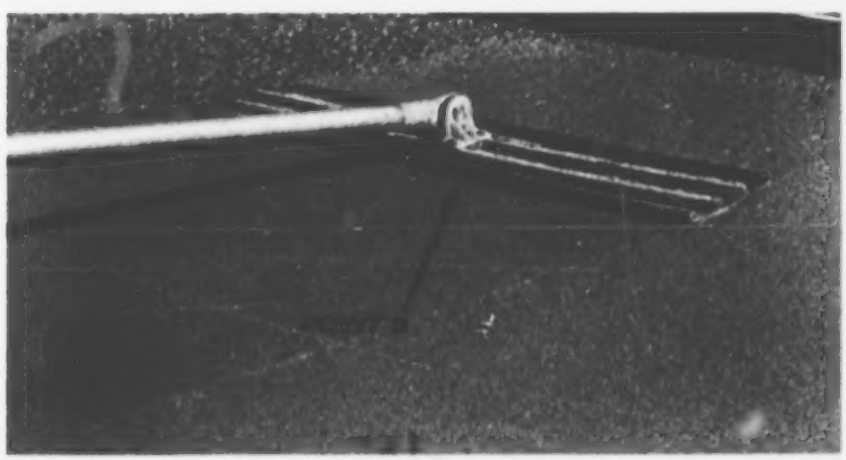
   (NOTE: This procedure helps break the vacuum under the blade and prevents dishing of the concrete surface.)

FIGURE 24



5. When you reach end of forward stroke, raise handle slightly and without hesitating start return stroke, keeping leading edge of blade (Point B) raised very slightly (almost flat) to concrete surface (Figure 25)

FIGURE 25



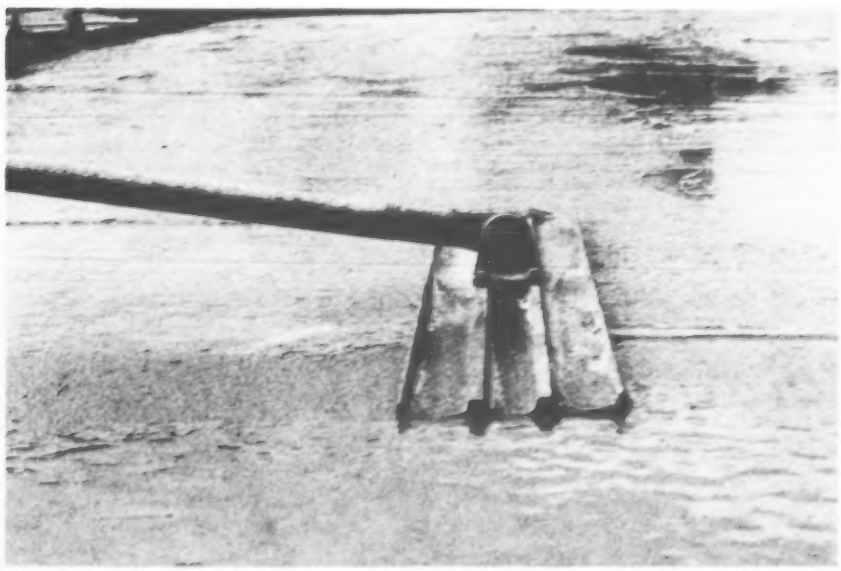
JOB SHEET #5

6. If necessary, make another forward stroke, keeping blade as flat as possible while preventing blade edges from digging into concrete surface

C. Make second pass

1. Place bullfloat so that blade will overlap first pass by at least 6 inches (Figure 26)

FIGURE 26



2. Repeat procedures in Step B, 2 through 6

D. Continue until slab has been completely bullfloated, overlapping passes by at least 6 inches and following procedures in Step B, 2 through 6

(NOTE: To improve levelness of slab, it is sometimes necessary to bullfloat crosswise to first bullfloating process. If this is necessary, follow Steps A through D to complete second bullfloating process.)

E. Have instructor inspect your work

F. Clean tools and work area; properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #6 — USE A HAND FLOAT
AND A FINISHING TROWEL

I. Tools and equipment

A. Hand float

B. Large finishing trowel

C. Kneepads

D. Concrete or sand pad

E. Protective clothing

II. Procedure

(NOTE: Through experience, you will eventually know when it is appropriate to begin the floating process. However, for now, check with your instructor before performing this job sheet.)

A. While holding hand float in dominant hand and trowel in the other hand, position yourself on your knees near edge of forms

B. Lean out over edge of concrete, supporting yourself on trowel (Figure 27)

(NOTE: This position allows you to reach further out.)

FIGURE 27

JOB SHEET #6

C. Make first pass with hand float

1. Hold float flat on concrete surface (See Figure 28)
2. Move float in a wide, semicircular motion (Figure 28)

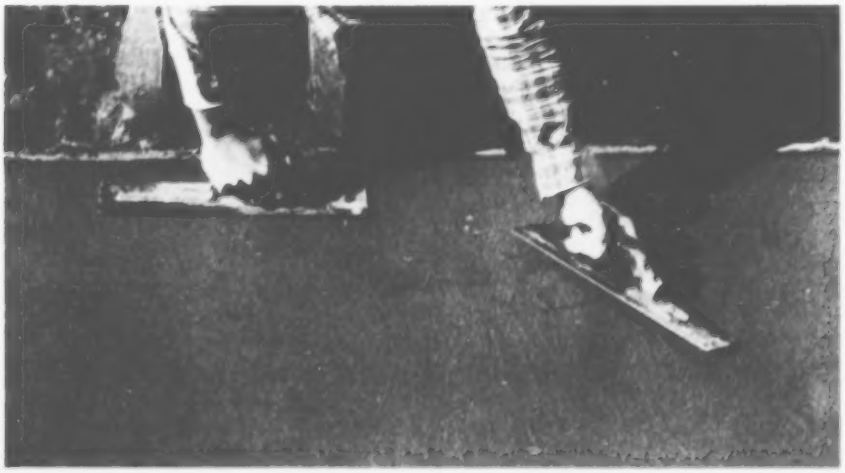
FIGURE 28

3. Level high spots or imperfections by using a forward-and-backward sawing motion of the float

D. Maintain position and make second pass with hand float

1. Move float back (toward you), while overlapping first pass (Figure 29)

FIGURE 29



JOB SHEET #6

2. Follow procedures in Step C for completing pass

E. Maintain position and continue floating, following procedures in Steps C and D, until all of area you can reach has been floated except area along form edge

F. Reposition yourself and float area along edge of forms, moving float at a right angle to form; continuing until entire edge has been floated (Figure 30)

FIGURE 30

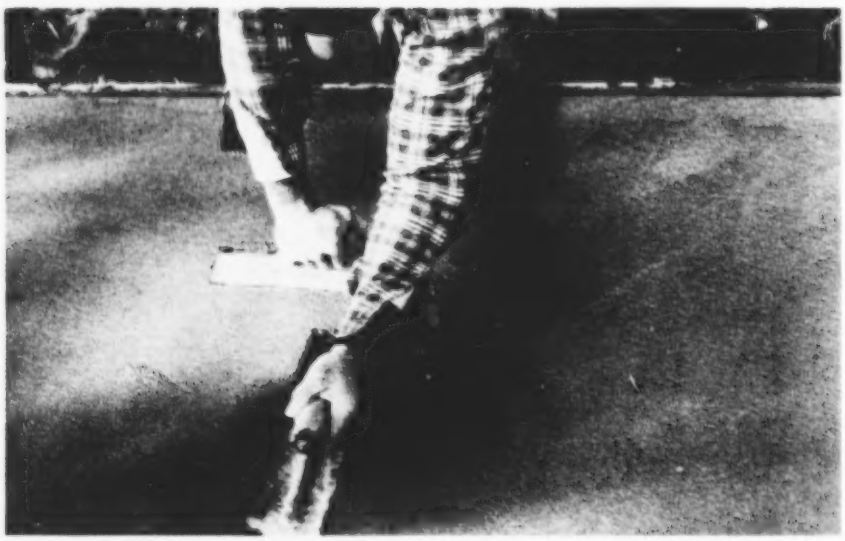
G. Reposition yourself as in Steps A and B, but place trowel in dominant hand and float or trowel in the other hand (See Figure 31)

H. Make first trowel pass

1. Hold trowel flat on concrete surface

2. Move trowel in a wide, semicircular motion (See Figure 31)

FIGURE 31



I. Maintain position and make second pass with trowel

1. Move trowel back (toward you), while overlapping first pass (Figure 32)

FIGURE 32

2. Follow procedures in Step H for completing pass

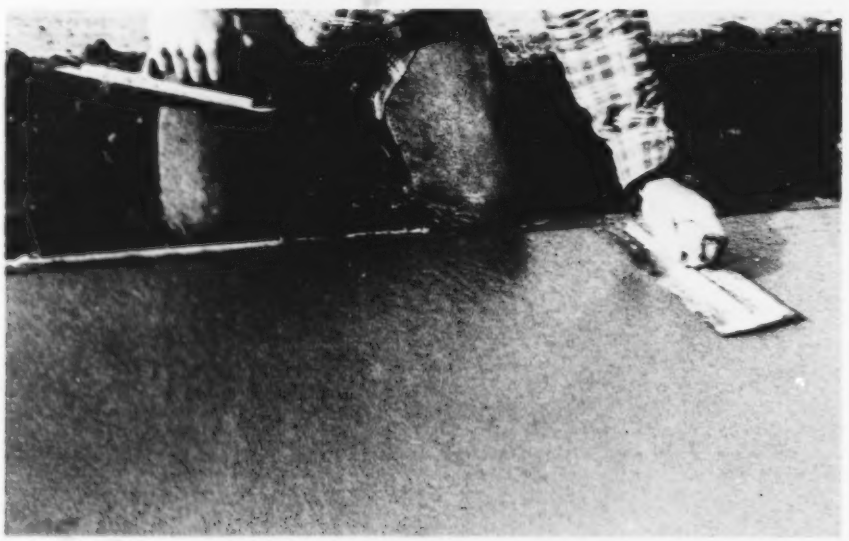
JOB SHEET #6

J. Maintain position and continue troweling, following procedures in Steps H and I, until all of area you can reach has been troweled except area along form edge (Figure 33)

FIGURE 33

K. Reposition yourself as in Step F, and trowel area along edge of forms, moving trowel at right angle to form (Figure 34)

FIGURE 34



JOB SHEET #6

L. Continue positioning yourself along form edge and following Steps A through K to float and trowel until entire slab has been floated and troweled

(NOTE: As concrete hardens and moisture evaporates, the concrete may have to be troweled another time or two [sometimes even more]. On each successive troweling, you should use a smaller trowel and tilt the blade a little more. You will find that as the concrete hardens you will need to increase the pressure placed on the trowel in order to remove imperfections as you trowel.)

M. Have instructor inspect your work

N. Clean work area and tools, and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #7 — USE AN EDGER

I. Tools and equipment

A. Margin trowel

B. Edger

C. Kneepads

D. Concrete or sand pad

E. Protective clothing

II. Procedure

A. Float and trowel slab edges (See Job Sheet #6)

B. Position yourself on your knees near edge of forms

C. Make arm's length pass with margin trowel to cut along inside of form

(NOTE: Making a pass with a margin trowel helps to force the aggregate away from the form and makes it easier to use the edger.)

D. Make arm's length pass with edger

1. Hold edger with leading edge (Point A) raised just enough to keep edger from digging into concrete and with rear edge (Point B) pressed down lightly (Figure 35)

FIGURE 35

JOB SHEET #7

2. Begin forward stroke by gliding edger across top of concrete until your arm is nearly fully extended

   (NOTE: *Do not* press too hard on the edger; the edger should make hardly any indentation on the top surface of the concrete.)

3. At end of forward stroke (when arm is fully extended), lift edger from concrete while edger is still in forward motion

   (NOTE: If the edger is not in motion when it is removed from the concrete, the concrete surface may be pulled up with the edger.)

4. With arm still extended, begin return stroke, drawing edger backward (toward you) with leading edge (Point B) tilted up slightly (Figure 36)

FIGURE 36

JOB SHEET #7

5. At end of return stroke, lift edger from concrete surface while edger is still in motion (Figure 37)

FIGURE 37

E. Continue repositioning yourself and edging, following the procedures in Steps C and D, until slab has been completely edged

F. Have instructor inspect your work

G. Clean work area and tools, and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #8 — OPERATE A POWER TROWEL MACHINE

I. Tools and equipment

A. Trowel machine with float shoes attached

B. Gasoline in gas can with funnel or spout

C. Can of oil and spout

D. Fire extinguisher

E. Hand trowel

F. Concrete pad

G. Protective clothing

1. Hard hat
2. Long-sleeved shirt
3. Gloves

II. Procedures

A. Check trowel machine off slab

1. Visually check machine to be sure all guards, safety devices, and belts are in place and that blades are in good condition; notify instructor if repairs are necessary
2. Check gasoline and oil levels and fill if necessary

CAUTION

Never fill machine with gasoline or oil while machine is on the slab.

B. Check to be sure there is proper ventilation

C. Check to be sure concrete is firm enough for floating and troweling procedures

(NOTE: The slab is ready for floating and troweling when an average-sized person leaves only a slight footprint impression on the surface of the concrete.)

D. Position trowel machine on slab at hardest point on slab

(NOTE: Usually the hardest point on the slab will be at the location where the concrete was first placed—at one corner of the slab and close to the edge form. See Figure 38.)

JOB SHEET #8

E. Adjust float blades for floating process: so that blades are almost flat

F. Start trowel machine

G. Make first floating pass, using the following guidelines

1. Move machine across slab at right angle to direction of bullfloating process (See Figure 39)

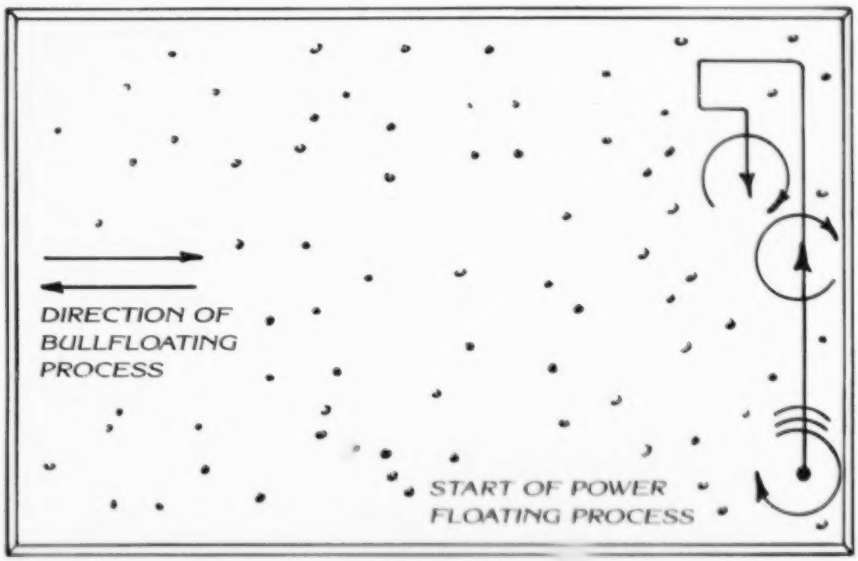
   a. Move machine right by gently pushing down on machine handle

   b. Move machine left by gently lifting machine handle

2. *Do not* operate machine in one spot for any length of time as this tends to dish out a low place in the concrete

3. Continue across slab until opposite edge is reached (Figure 38)

FIGURE 38



H. Immediately step back and maneuver trowel machine into position to make second floating pass, using the following guidelines

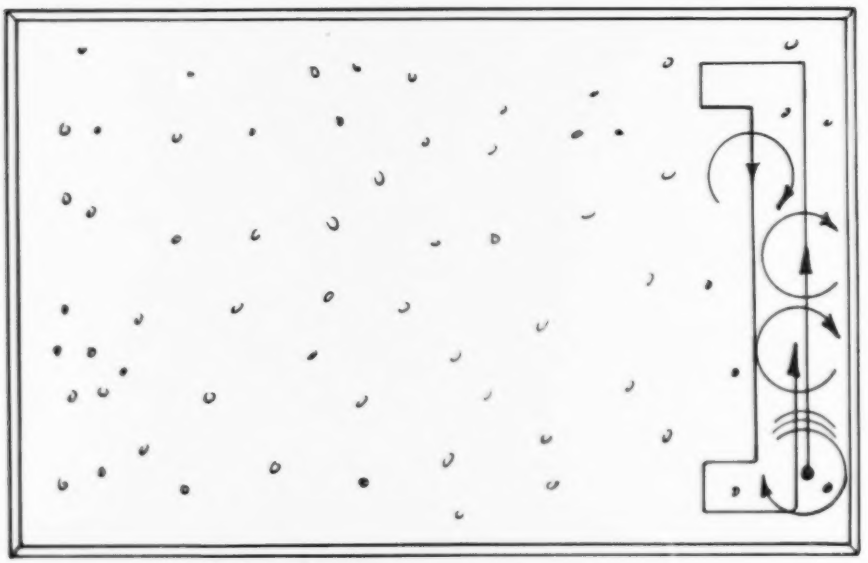
(NOTE: Remember *not* to operate machine in one spot for any length of time.)

1. Maneuver machine so that it will overlap first pass by about one-half the blade width (See Figure 39)

JOB SHEET #8

2. Move machine across slab at right angle to direction of bullfloating process (as in the first pass), but use a sweeping motion that follows a consistent pattern such as the pattern shown in Figure 39

FIGURE 39



3. As you move machine across slab, work out footprints and other imperfections

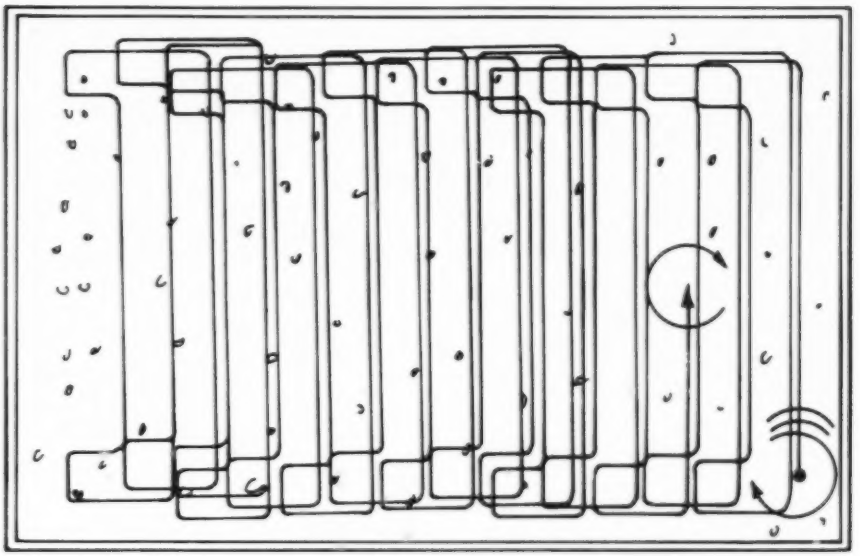
   (NOTE: Occasionally you may need to fill a hole by hand rather than by filling with the trowel machine. Carry a hand trowel in your pocket for this purpose.)

4. Continue across slab until opposite edge is reached

I. Continue making floating passes, following the procedures in Step H, until slab has been completely floated (See Figure 40)

JOB SHEET #8

FIGURE 40



J. Move trowel back to the starting position on slab

K. Remove float blades

L. Adjust trowel blades for first troweling process: so that blades are relatively flat

(NOTE: As concrete hardens, the blades should be tilted a little more with each successive troweling.)

M. Start trowel machine

N. Make first troweling pass, using the following guidelines

1. Move machine across slab at right angle to direction of floating process (See Figure 41)

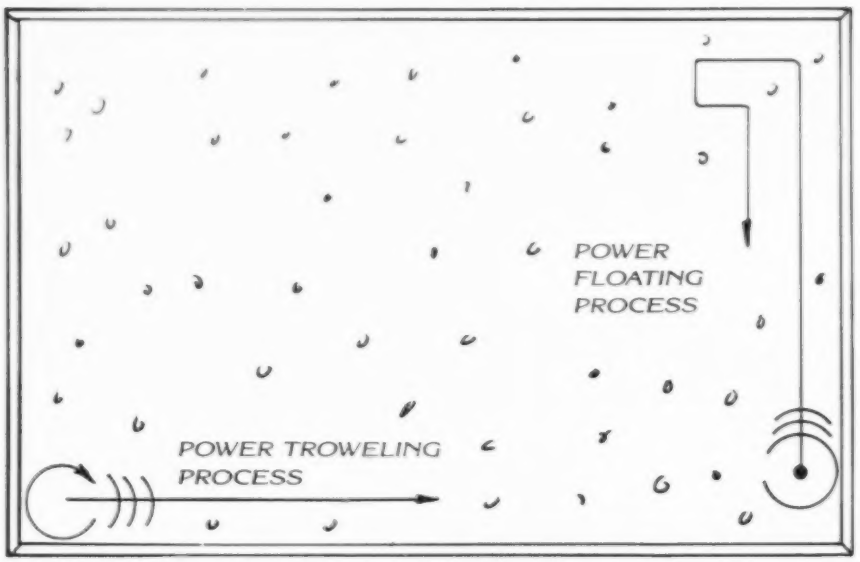
   a. Move machine right by gently pushing down on machine handle

   b. Move machine left by gently lifting machine handle

2. *Do not* operate machine in one spot for any length of time as this tends to dish out a low place in the concrete

JOB SHEET #8

FIGURE 41



3. Continue across slab until opposite edge is reached

O. Immediately step back and maneuver trowel machine into position to make second troweling pass, using the following guidelines

(NOTE: Remember *not* to operate machine in one spot for any length of time.)

1. Maneuver machine so that it will overlap first pass by about one-half the blade width

2. Move machine across slab at right angle to direction of floating process (as in first troweling pass), but use a sweeping motion that follows a consistent pattern

3. As you move machine across slab, work out footprints and other imperfections

(NOTE: Occasionally you may need to fill a hole by hand rather than by filling with the trowel machine. Carry a hand trowel in your pocket for this purpose.)

4. Continue across slab until opposite edge is reached

P. Continue making troweling passes, following the procedures in Step O, until slab has been completely troweled one time

JOB SHEET #8

Q. Continue troweling process until desired finish is accomplished

(NOTE: The number of trowelings required and the waiting period between trowelings depends on the way the concrete sets and on the type of finish desired.)

R. Remove trowel machine from slab

S. Have instructor inspect your work

T. Clean and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

JOB SHEET #9 — OPERATE AN ELECTRIC SPRAYER

I. Tools and equipment

A. Electric sprayer unit

B. Heavy-duty spray nozzle

C. Two sections of water hose (to be used as inlet and outlet hoses for the sprayer unit)

(NOTE: The section of hose to be used as the outlet hose should be long enough to reach the entire area that is to be sprayed. The section of hose to be used as the inlet hose needs only to be long enough to reach from the sprayer unit into the curing-compound container.)

D. Container of curing compound

E. Extension cord of sufficient size

F. Container of clean water

G. Safety equipment and protective clothing

1. Hard hat

2. Goggles

3. Gloves

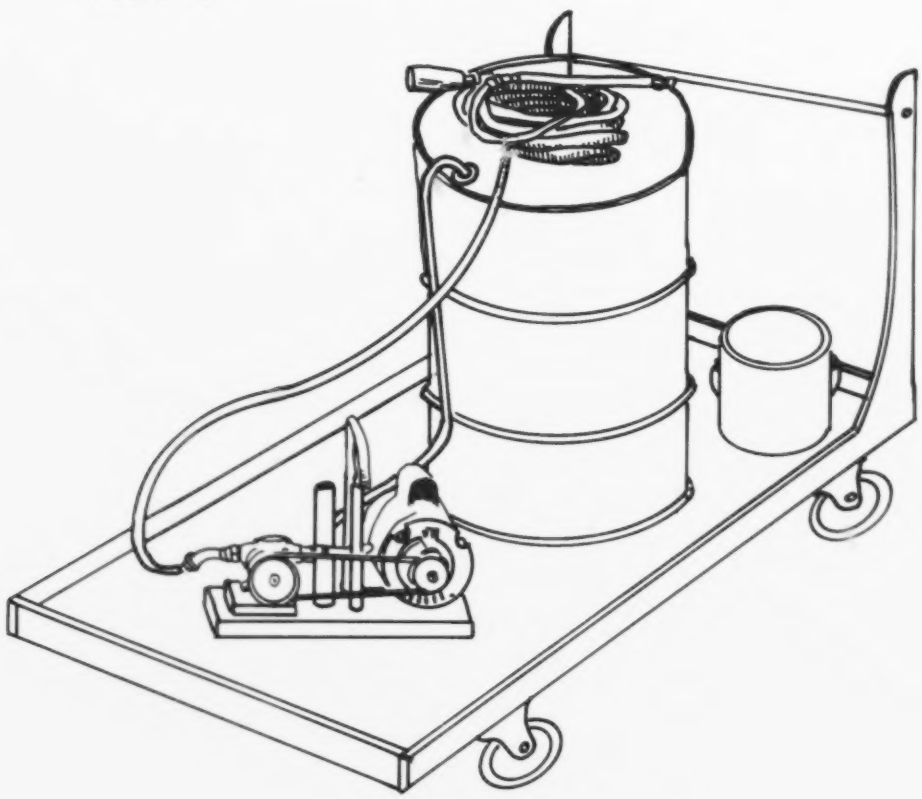
4. Long-sleeved shirt

JOB SHEET #9

II. Procedure

A. Check electric sprayer unit and related equipment (Figure 42)

FIGURE 42



1. Visually check sprayer unit to be sure all guards and safety devices are in place; notify instructor if repairs are necessary

2. Check condition of extension cord and connections; replace as necessary

3. Check hoses and connections to make sure they are in good condition; replace as necessary

B. Set sprayer unit near slab at location where it will be convenient to use; set container of curing compound and container of water beside sprayer unit

(NOTE: If at all possible, you should *not* step on the slab while spraying. Spray while standing near the edge of the slab, and locate the sprayer unit where it will be convenient to do so.)

JOB SHEET #9

C. Plug sprayer unit into extension cord

D. Place end of inlet hose in container of curing compound

E. Put on safety equipment

F. Pick up outlet hose and point nozzle toward slab

G. Turn on sprayer unit and adjust nozzle so that curing compound will be distributed properly

(NOTE: With experience you will know when the nozzle is adjusted properly, but for now, check with your instructor before proceeding with the spraying process.)

H. Make first pass with sprayer, beginning at one end of slab and working back and forth across slab

I. Continue making passes until slab has been covered with curing compound

(NOTE: Sometimes it is necessary to cover slab with a second coat of curing compound. If this is necessary, make passes at right angle to passes in first spray pattern.)

J. Just before slab has been completely covered with compound, remove inlet hose from curing-compound container to begin clearing compound from hose and sprayer unit

K. Place inlet hose in container of water, point nozzle away from slab, and continue running pump until water coming from inlet hose is free of curing compound

CAUTION

Do not spray water onto slab.

(NOTE: Some curing compounds are colored, and you will be able to tell by looking at the water coming from the outlet hose when the water is clear of compound. However, some curing compounds are clear, and you will have to feel and smell the water coming from the outlet hose to determine when the water is clear of compound.)

L. Turn off sprayer unit

M. Have instructor inspect your work

N. Clean work area and equipment, and properly store tools and equipment

CONCRETE BASIC SKILLS
UNIT IV

TEST

NAME _____ SCORE _____

1. Match terms and definitions associated with concrete basic skills. Write the correct numbers in the blanks.

_____a.	Piece of wood inserted between forms to temporarily hold forms the proper distance apart	1. Scab
_____b.	Attainment of significant rigidity	2. Flush
_____c.	Not tight; sagging	3. Concrete set
_____d.	Liquid coating applied to newly placed concrete to maintain a satisfactory moisture content and favorable temperature in concrete during the early stages so that desired properties may develop	4. Kerf
_____e.	Even with; having or forming a continuous plane or unbroken surface	5. Slack
_____f.	Term used meaning to float and trowel surface of a concrete slab the first time	6. Lay down concrete
_____g.	Piece of material fastened across a splice or joint to strengthen and hold the two pieces together	7. Curing compound
_____h.	Shallow saw-cut in which to fit line to hold it in place	8. Spreader

2. State eight basic skills necessary to construct forms, place, and finish concrete.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

TEST

g. _____

h. _____

3. Distinguish between edge forms, bulkheads, and screeds according to their characteristics. Write an "E" in the blank before the description of edge forms, a "B" before the description of bulkheads, and an "S" before the description of screeds.

_____a. Forms used to contain concrete and to cut off concrete pour; sometimes used as a guide when rodding concrete to established grade; removed after concrete has set

_____b. Temporary guides used to support straightedge when rodding concrete to an established grade; usually set no more than 12 feet apart; removed after concrete is placed

_____c. Low forms placed at perimeter of slab to contain the concrete; used to limit horizontal spread of fresh concrete; removed after concrete has set

4. Distinguish between placing and rodding. Write an "X" in the blank before the definition of rodding.

_____a. Process of leveling concrete to an established grade

_____b. Process of delivering concrete from the supply and placing it at the established area inside the forms

5. Arrange in order steps to take when placing and finishing a concrete slab. Write a "1" in the blank before the first step, a "2" before the second step, and so on.

_____a. Hand float

_____b. Finish

_____c. Bullfloat or darby

_____d. Re-edge

_____e. Apply curing compound

_____f. Place concrete

_____g. Cut joints when appropriate

_____h. Edge

_____i. Rod or straightedge

_____j. Trowel

TEST

6. State two factors to look for prior to starting finishing procedures.

   a. _____

   b. _____

(NOTE: Test item 7 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Demonstrate the ability to

   a. Set and drive nails with a nail hammer.

   b. Use a crosscut hand saw.

   c. Construct edge forms for a sidewalk.

   d. Construct edge forms for a slab on grade.

   e. Use a bullfloat.

   f. Use a hand float and finishing trowel.

   g. Use an edger.

   h. Operate a power trowel machine.

   i. Operate an electric sprayer.

CONCRETE BASIC SKILLS
UNIT IV

ANSWERS TO TEST

1. a. 8
   b. 3
   c. 5
   d. 7
   e. 2
   f. 6
   g. 1
   h. 4

2. Answer should include any eight of the following.

   a. Ability to use a rule and tape accurately
   b. Ability to use a square accurately
   c. Ability to use a nail hammer properly
   d. Ability to use a handsaw properly
   e. Ability to drive stakes straight and plumb with a sledge hammer
   f. Ability to use a hand level and a builder's level properly and accurately
   g. Ability to rod concrete level
   h. Ability to use a bullfloat properly
   i. Ability to use a float and trowel to lay down concrete
   j. Ability to use an edger to finish edges of concrete
   k. Ability to use a jointer to cut joints in concrete
   l. Ability to use a power trowel machine to lay down concrete
   m. Ability to use a hand trowel to finish concrete
   n. Ability to use a power trowel machine to finish concrete
   o. Ability to use a power sprayer to apply curing compound

3. a. B
   b. S
   c. E

4. A

5. a. 4
   b. 9
   c. 3
   d. 8
   e. 10
   f. 1
   g. 7
   h. 5
   i. 2
   j. 6

6. Answer should include any two of the following.

   a. Concrete hardening
   b. Bleed water should be gone
   c. Water sheen should be gone
   d. Glossy appearance not noticeable

7. Performance skills evaluated to the satisfaction of the instructor.